CHILDREN'S EDUCATION SOCIETY (Regd.)
THE OXFORD COLLEGE OF ENGINEERING
(Recognised by the Govt. of Karnataka, Affiliated to Visvesvaraya Technological University, Belagavi.
Approved by A.I.C.T.E. New Delhi.
Recognised by UGC Under Section 2(f)
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Sample Course file & Mentor book

Index

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Bengaluru-560 068

THE OXFORD COLLEGE OF ENGINEERING

Hosur Road, Bommanahalli, Bengaluru-560 068

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(Approved by AICTE, New Delhi, Accredited by NBA, New Delhi & Affiliated to VTU Belgaum)

DEPARTMENT OF MECHATRONICS ENGINEERING

COURSE FILE

Faculty Name	Mr. Dhananjaya V
Subject Name	Micro and Smart System Technology and Micro and Smart System Technology Lab
Subject Code	15MT54/15MTL58
Semester	Vth Semester
Academic year	2018-19

PRINCIPAL
The Oxford College of Engineering
Bommanahalli, Hosur Road
Bengaluru-560 068

MICRO & SMART SYSTEMS TECHNOLOGY
(15MT54)

CONTENTS

HOD, MTE

Prof. & HOD
Department of Mechatronics
The Oxford College Of Engineering
Bommanahalli, Bangalore - 560 068.

THE OXFORD COLLEGE OF ENGINEERING

VISION OF THE INSTITUTE

To be a respected and most sought after engineering educational institution engaged in equipping individuals to be capable of building learning organization in the new millennium.

MISSION OF THE INSTITUTE

To develop competent students with good value systems to face challenges of the continuously changing world.

DEPARTMENT OF MECHATRONICS ENGINEERING

VISION

To develop the Mechatronics engineering department as a leading educational and research department with innovation in the design and development of electro-mechanical systems, intelligent machines and product.

DEPARTMENT OF MECHATRONICS ENGINEERING

MISSION

Mission of the Department	
M1	To provide an outstanding education in Mechatronics engineering with a rich diversity of skills
M2	To contribute to the community prosperity through professional services and research
M3	To prepare graduates with ability to engage in life long learning and capable of carrying out engineering practice with competence.

PROGRAM EDUCATION OBJECTIVES (PEOS)

PEO 1:	Include knowledge of basic engineering sciences and fundamentals of mechanical, electrical and computer systems.
PEO 2:	Create ability in graduates to design, develop product and applications in the field of automation and Mechatronics and be able to use engineering tools that will enhance their productivity.
PEO 3:	Prepare graduates to be effective engineers with good analytical and problem solving skill to innovate, research and develop in a multidisciplinary Mechatronics environment.

CHILDREN'S EDUCATION SOCIETY (REGD.)
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TENTATIVE CALENDAR OF EVENTS FOR ODD SEMESTERS – 2018 - 19

Week No.	Month	Day						No. of working days	Activities
		Mon	Tue	Wed	Thu	Fri	Sat		
1	Aug		-	01 FWD	02	03	04	4	1st – First Working Day
2	Aug	06	07	08	09	10	11	6	
3	Aug	13	14	15 (H)	16	17	18	5	15th – Independence Day
4	Aug	20	21	22 (H)	23	24	25	5	22nd – Bakrid
5	Aug/Sep	27	28	29	30 T	31	1	6	
6	Sep	03 (T1)	04 (T1)	05 (T1)	06	07	08 (PTM)	6	03, 04 & 05th – First Internal Assessment
7	Sep	10	11	12	13 (H)	14	15	5	13th – Varasiddhi Vinayaka Vrata
8	Sep	17	18	19	20	21 (H)	22	5	21st - Last day of Moharam
9	Sep	24	25	26	27	28	29	6	
10	Oct	01	02 (H)	03	04 T	05	06	5	2nd – Gandhi Jayanthi
11	Oct	08 (H)	09	10	11	12	13	5	08th – Mahalaya Amavasye
12	Oct	15 (T2)	16 (T2)	17 (T2)	18 (H)	19 (H)	20 (PTM)	4	15th, 16th & 17th – Second Internal Assessment 18th – Maha Navami Ayudapooja 19th - Vijayadasami
13	Oct	22	23	24 (H)	25	26	27	5	24th – Maharshi Valmiki Jayanthi
14	Oct /Nov	29	30	31	01 (H)	02	03	5	1st – Kannada Rajyothsava
15	Nov	05	06 (H)	07	08 (H) T	09	10	4	06th – Naraka Chaturdashi 08th – Balipadyami Deepavali
16	Nov	12 (T3)	13 (T3)	14 (T3)	15	16	17 (PTM)	6	12, 13 &14 – Third Internal Assessment
17	Nov	19	20 (LWD)	-	-	-	-	-	---------

Dr. R V Praveena Gowda
Principal, TOCE
Dr. R V Praveena Gowda
Principal
The Oxford College of Engineering
Bommanahalli, Hosur Road

THE OXFORD COLLEGE OF ENGINEERING

HOSUR ROAD, BOMMANAHALLI, BENGALURU-560 068

MECHATRONICS ENGINEERING DEPARTMENT

TIME & DATE	9-9:55	9:55-10:50	11-11:55	11:55-12:50	1:30-2:25	2:25-3:20	3:20-4:15
MONDAY	THERMAL (15MT72)		THERMAL (15MT72)	MEMS (15MT54)			MST (17MT32
TUESDAY		MEMS LABORATORY (15MTL58)				MST (17MT32)	
WEDNESDAY	MST (17MT32)		MEMS (15MT54)		THERMAL (15MT72)		
THURSDAY		MEMS LABORATORY (15MTL58)				MEMS (15MT54)	
FRIDAY		THERMAL (15MT72)		MST (17MT32)			
SATURDAY	MEMS (15MT54)						

FACULTY INCHARGE : DHANANJAYA . V

Faculty Sign

Signature of HOD

Prof. & HOD
Department of Mechatronics
The Oxford College of Engineering
Bommanahalli, Bangalore

Course: B.E. Sem: 7 Semester Room No.: 604

TIME / DAY	9:00-9:55	9:55-10:50	5 1 - 1	11:00-11:55	11:55-12:50		13:30-14:25	14:25-15:20	15:20-16:15
MON	THERMAL (DhananJaya)	ROBOTICS (Murugan)	SHORT	THERMAL (DhananJaya)	PHASE-1 (Rajeshwari)	LUNCH BREAK	S&S (Chethan)	ROBOTICS (Murugan)	T/R/S
TUE	RTS (Tulasi)	S&S (Chethan)		RTS (Tulasi)	DSP (Aishwarya)		THERMAL (Dhananhaya)	RTS (Tulasi)	T/R/S
WED	S&S (Chethan)	ROBOTICS/DSP lab (Murugan/Aishwarya)					THERMAL (Dhananhaya)	RTS (Tulasi)	
THU	DSP (Aishwarya)	ROBOTICS (Murugan)	REA	DSP (Aishwarya)	S&S (Chethan)		T/R/S		
FRI	S&S (Chethan)	ROBOTICS/DSP lab (Murugan/Aishwarya)					DSP (Aishwarya)	T/R/S	
SAT	Project training sessions								

SUB. CODE	SUBJECT	NAME OF THE FACULTY
15MT71	INDUSTRIAL ROBOTICS	Mr Thirumurugan N
15MT72	THERMAL ENGINEERING	Mr Dhananjaya V
15MT73	SIGNAL PROCESSING	Mrs Rani Aishwaryan S N/Rani T S
15MT743	REAL TIME SYSTEM	Mrs Tulasi K L
15MT753	SAFETY AND SECURITY OF MECHATRONICS SYSTEM	Mr Chethan S
15MTL76	ROBOTICS LAB	Mr Thirumurugan N/Rani T S
15MTL77	SIGNAL PROCESSING LAB	Mrs Rani Aishwaryan S N
15MTP78	PROJECT PHASE 1 -SEMINAR	Mr Rajeshwari M
CLASS TEACHER:	Ms. Rani Aishwaryan S N	

Time Table Coordinator

Chief Time Table Coordinator

Professor & HOD of E&C Engineering
The Oxford College of Engineering
Hosahalli, Bangalore-560 068.

Head of the Department

Principal

Course: B.E. Sem: V Semester Room No.: 603

TIME / DAY	9:00-9:55	9:55-10:50		11:00-11:55	11:55-12:50		13:30-14:25	14:25-15:20	15:20-16:15
MON	DME (Chethan)	VI (Rajeshwari)		H & N (Murugan)	MEMS (Dhananjaya/Rajesh B)		AIM (Murugan)	WNC (Aishwarya)	T/R/S
TUE	VI (Rajeshwari)	VI/MEMS lab (Rajeshwari/Dhananjaya)					T/R/S		
WED	H & N (Murugan)	DME (Chethan)		MEMS (Dhananjaya/Rajesh B)	VI (Rajeshwari)		DME (Chethan)	AIM (Murugan)	
THU	AIM (Murugan)	VI/MEMS lab (Rajeshwari/Dhananjaya)					WNC (Aishwarya)	MEMS (Dhananjaya)	T/R/S
FRI	AIM (Murugan)	WNC (Aishwarya)		DME (Chethan)	WNC (Aishwarya)		T/R/S		
SAT	MEMS (Dhananjaya/Rajesh B)	H & N (Murugan)		VI (Rajeshwari)	H & N (Murugan)				

LUNCH BREAK

SUB. CODE	SUBJECT	NAME OF THE FACULTY
15MT51	Design Of Machine Elements	Mr Chethan S
15MT52	Virtual Instrumentation	Mrs Rajeshwari M
15MT53	Hydraulics and Pneumatics	Mr Thirumurugan N
15MT54	Micro and smart system technology	Mr Dhananjaya V/Rajesh B
15MT551	Wireless Network communication	Mrs Rani Aishwaryan S N
15MT562	Automation in Manufacturing	Mr Thirumurugan N
15MTL57	Virtual Instrumentation Lab	Mr Rajeshwari M
15MTL58	Micro and smart system technology Lab	Mr Dhananjaya V /Rajesh B
CLASS TEACHER:	Mr Thirumurugan N	

Professor & HOD of E&C Engineering
The Oxford College of Engineering
Bommanahalli, Bangalore-560 068.

Time Table Coordinator Chief Time Table Coordinator Head of the Department Principal

Course: B.E. Sem: 3 - Semester Room No.: 606

TIME / DAY	9:00-9:55	9:55-10:50		11:00-11:55	11:55-12:50		13:30-14:25	14:25-15:20	15:20-16:15
MON	ADE (Dr.Rohini)/Rani TS	MT/ADE lab (Chethan S/Tulasi K L)					CS (Tulasi KL)	CO (Rajeshwari)	T/R/S
TUE	MOM (Chethan)	Maths-III (selestina)		ADE (Dr.Rohini)/Rani TS	MOM (Chethan)		CS (Tulasi KL)	MST (Dhananjaya)	T/R/S
WED	MST (Dhananjaya)	CO (Rajeshwari)	SHORT BREAK	Maths-III (selestina)	Maths-III (selestina)	LUNCH BREAK	ADE (Dr.Rohini)/Rani TS		
THU	ADE (Dr.Rohini)/Rani TS	MOM (Chethan)		CS (Tulasi KL)	Maths-III (selestina)		T/R/S		
FRI	CS (Tulasi KL)	CO (Rajeshwari)		Maths-III (selestina)	MST (Dhananjaya)		MOM (Chethan)		
SAT	CO (Rajeshwari)	MT/ADE lab (Chethan S/Tulasi K L)							

SUB. CODE	SUBJECT	NAME OF THE FACULTY
17MT31	Engineering Mathematics III	selestina
17MT32	Material science and metullurgy	Mr Dhananjaya V
17MT33	Mechanics of Materials	Mr Chethan S
17MT34	Control System	Mrs Tulasi K L
17MT35	Analog and Digital Electronics	Dr. Rohini Deshpande/Rani TS
17MT36	Computer Organization	Mr Rajeshwari M
17MTL37	Mechanical Lab- I	Mr Chethan S
17MTL38	analog and Digital Electronics lab	Mr Tulasi K L
CLASS TEACHER:	Ms Chethan S	

Time Table Coordinator

Chief Time Table Coordinator

Professor & HOD of E&C Engineering
The Oxford College of Engineering
Hosur Road, Bangalore-560 068.

Head of the Department

Principal

MICRO & SMART SYTEMS TECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15MT54	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course Objectives: Students will be able to

1. gain knowledge of Smart Materials, Sensors & Actuators, Microsystems.
2. understand the Operation of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Modules	Hours Teaching	Revised Bloom's Taxonomy(RBT) Level
Module -1		
Introduction to Micro and Smart systems: Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems ,Application of Smart Materials & Microsystems.	10 Hours	
Module -2		
Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems.Sensors: silicon capacitive accelerometer, piezoresistive pressure sensor, Portable blood analyzer, conductometric gas sensor. Actuators: Micromirror Array for Video Projection, Piezo-electric based inkjet print head,electrostatic comb-drive, Magnetic microrelay.	10 Hours	
Module -3		
Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micromachining:surface micromachining bulk micromachining. Specialized Materials for Microsystems.	10 Hours	
Module -4		
Electronics Circuits for Micro and Smart Systems. Semiconductor devices: Diode, Schottky diode,Tunnel diode,BJT ,MOSFET,CMOS circuits ,Electronics Amplifiers ,Op-Amp based circuits ,Practical Signal Conditioning Circuits for Microsystems. Circuits for Conditioning Sensed Signals.	10 Hours	

Module -5		
Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems. Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor, design considerations, performance parameters, practical implementations, design of electronics circuits, Integration of pressure Sensor and Smart Structure in vibration control.	**10 Hours**	

Course Outcomes: On completion of the course the student will

1. have knowledge of Smart Materials, Sensors & Actuators ,Microsystems.
2. understand the Working Methodology of Smart Devices & Systems, Electronics Circuits & Control for MEMS, Methodology of Micro-manufacturing.

Graduate Attributes (as per NBA):

Question paper pattern:

- The question paper will have TEN questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with maximum of FOUR sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books :

1.Micro and Smart Systems: G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre,Wiley India 2010.

Reference Books:

1. Design and Development Methodogies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Goplakrishnan, Wiley.
2. MEMS- Nitaigour Premchand Mahalik, TMH 2007.
3. MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill.

LESSON PLAN (SUBJECT - 3)

Semester : V SEM

Subject with Code : 15 MT 54 (MEMS)

Week	Hour	Date	Topic to be covered
1			
2			
	1	11/08/18	Introduction to micro and Smart S/m's,
3	4	13/08/18	micro system, micro sensors and micro actuators
	6	16/08/18	miniaturization, uses, S
	1	18/08/18	Smart materials and systems.
4	4	20/08/18	Integrated micro-systems, multidisciplinary aspects, M S/m
	6	23/08/18	Applications of Smart materials & M. systems or MEMS
	1	25/08/18	Micro & Smart devices, & features of Sensors, Actuators, S/m
5	4	27/08/18	Sensors, and types of Sensors, 1. Silicon capacitive accld.
	3	29/08/18	Piezoresistive pressure sensor, portable blood analyser.
	6	30/08/18	Conductometric gas sensor.
	1	01/09/18	Actuator : types, 1. micro-mirror array for video projection.
6	6	06/09/18	Piezo - Electric based Inkjet head.
	1	08/09/18	Electro - static comb drive, magnetic micro relay.
7	4	10/09/18	Silicon as a material for micro - machining.
	3	12/09/18	Silicon wafer preparation.
	1	15/09/18.	thin film deposition technique.

LESSON PLAN (SUBJECT - 3)

Semester : V SEM Subject with Code : 15 MT 54 (MEMS)

Week	Hour	Date	Topic to be covered
8	4	17/09/18	Lithography process.
	3	19/09/18	Etching technique
	6	20/09/18	Silicon micro maching : surface & bulk micromachining
	1	22/09/18	Specialized materials for micro-systems.
9	4	24/09/18	Semi-conductor devices, Diode, schottky diode...
	3	26/09/18	BJT
	6	27/09/18	MOSFET
	1	29/09/18	CMOS circuits
10	4	01/10/18	Electronic Amplifiers
	3	03/10/18	Op-Amp based Circuits
	6	04/10/18	practical Signal Conditioning Circuits for M. Systems
	1	06/10/18	Circuits for Conditioning Sensor Sensed Signals.
11			
	3	10/10/18	Design methodology
	6	11/10/18	PID Controller
	1	13/10/18	Circuit Implementation
12			
	1	20/10/18	Digital Controller
13	4	22/10/18	Micro-controller & PLC
	6	25/10/18	Case studies of Integrated Bi μ s/m : BEL pressure sensor
	1	27/10/18	Design Considerations, performance parameters.
14	4	29/10/18	practical implimentations,
	3	31/10/18	Design of Electronic Circuits
	1	03/11/18	Integration of pressure sensor & Smart structure in Vibration control.

FACULTY INCHARGE

Prof. R. Rao
HOD, MTE

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DEPARTMENT OF MECHATRONICS ENGINEERING

LIST OF 3RD MECHATRONICS ENGINEERING STUDENTS

Sl No	USN	STUDENTS NAME
1	1OX17MT002	AHMED ADEEL GAZALI
2	1OX17MT004	AKSHAY KUMAR REDDY
3	1OX17MT007	AMAN RAJ
4	1OX17MT008	ANNIESH D K
5	1OX17MT009	BHARATH KUMAR L
6	1OX17MT010	BRUNDHA J
7	1OX17MT011	CHETHAN M
8	1OX17MT012	DARSHAN K N
9	1OX17MT013	DEEKSHITH G S
10	1OX17MT014	DESHNA MOHANTY
11	1OX17MT016	JEEVITH R
12	1OX17MT017	K VISHNU
13	1OX17MT018	KIRAN S
14	1OX17MT019	KISHORE S
15	1OX17MT020	MANISH CHANDRA V
16	1OX17MT022	MONICA P
17	1OX17MT023	MONISH PRAKASH A
18	1OX17MT024	MUNNAKUMAR PANDIT
19	1OX17MT025	MURULI KRISHNA N
20	1OX17MT027	NIKHIL SRINIVAS K R
21	1OX17MT028	SAM CHRISTOPHER P
22	1OX17MT031	RASHMI R
23	1OX17MT032	SANJAY J
24	1OX17MT033	SANJAY R
25	1OX17MT034	SHREESHA N BHAT
26	1OX17MT035	SHREYA BIRADAR G
27	1OX17MT038	UDAY KUMAR K
28	1OX17MT039	VARSHADHARE K
29	1OX17MT040	VARUN

30	1OX17MT041	VIJAY D
31	1OX17MT042	VIJAYALAKSHMI S
32	1OX17MT043	VINAY KUMAR T V
33	1OX17MT044	VISHAL B S
34	1OX17MT045	VISHNU MANOHAR TUMSI S
35	1OX17MT046	VISHNU S KUMAR
36	1OX16MT022	MANJUNATH PRABHU M R
37	1OX16MT003	AKANKSHA V REDDY
38	1OX18MT400	BHARATH N
39	1OX18MT401	BHARGAV B S
40	1OX18MT402	DIXIT H M
41	1OX18MT403	HEMANTH REDDY
42	1OX18MT404	JEEVA A
43	1OX18MT405	MOHAN BABU M
44	1OX18MT406	MOHAN KUMAR S
45	1OX18MT407	NIRANJAN S
46	1OX18MT408	OMKAR ZADAGE
47	1OX18MT409	PRAVEEN S SALIMATH
48	1OX18MT410	RASHISH KUMAR
49	1OX18MT411	THRILOK V
50	1OX18MT412	ZAHID AHMED

HOD, MTE
Prof. & HOD
Department of Mechatronics
The Oxford College of Engineering
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THE OXFORD COLLEGE OF ENGINEERING

DEPARTMENT OF MECHATRONICS ENGINEERING

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(Approved by AICTE, New Delhi, Accredited by NBA, New Delhi & Affiliated to VTUBelgaum)

Academic Year: AUG 18–DEC 18

INTERNAL TEST – I(CBCS Scheme)

SUB CODE: 15MT54 DATE: 04.09.2018

SUB NAME: Micro and Smart System Technology MAX MARK: 40M

SEM: V DURATION: 1Hr 30Mins

Answer any one full questions from each Part 5x6 =30marks

Q. No.	Part 1	Marks	COs,POs
Q1.	What are smart systems? Explain the components of a smart system with the help of a block diagram.	08	CO1,PO1
	OR		
Q2.	What are micro systems? Explain components of micro system? And mention the applications of micro system.	08	CO1,PO1
	Part 2		
Q3.	What is miniaturization? Mention the need and advantages of miniaturization of systems.	08	CO2,PO1
	OR		
Q4.	Elucidate the multidisciplinary aspects of Microsystems with the help of block diagram.	08	CO3,PO1
	Part 3		
Q5	Explain micro system as micro sensor and micro actuator with block diagram.	08	CO3,PO1
	OR		
Q6.	What are smart materials? Different types of smart materials and explain working of any two smart materials.	08	CO4,PO1
	Part 4		

Q7.	Explain sensors, actuators and systems. And write the characteristic features.	08	CO6,PO1
	OR		CO5,PO1
Q8.	Explain the working principle of silicon capacitive accelerometer with the diagram.	08	
	Part 5		
Q.9.	Explain the working principle of piezo-resistive pressure sensor with block diagram..	08	CO5,PO1
	OR		CO5,PO1
Q.10.	With the neat sketch explain the working of conductometric gas sensor.	08	

Course Outcomes

Students will be able to

1.	Know the basic concept of micro and smart system technology.
2.	Understand the need of micro size machines and devices.
3.	Know how this micro system technology is evolved in all fields of science amd technology
4.	Know the smart materials and their characteristics for the smart system applications.
5.	Understand the working of different sensors for smart system applications.
6.	Know how the different components of smart systems atc integrated with each other.

Faculty Signature

HOD Signature

Prof. & HOD

THE OXFORD COLLEGE OF ENGINEERING
DEPARTMENT OF MECHATRONICS ENGINEERING
Hosur Road, Bommanahalli, Bengaluru-560 068
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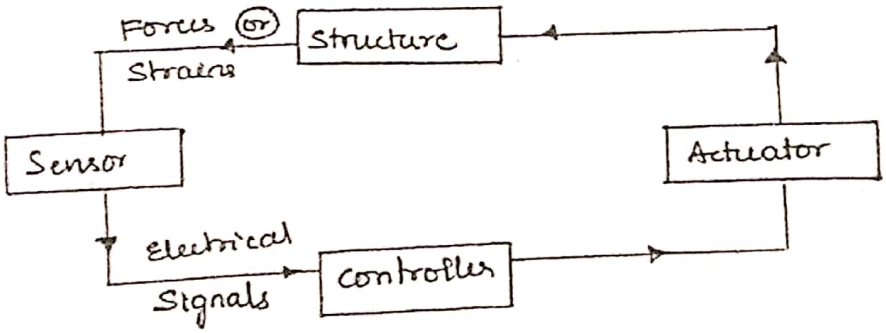
AICTE, New Delhi, Accredited by NBA, New Delhi & Affiliated to VTU, Belgaum)

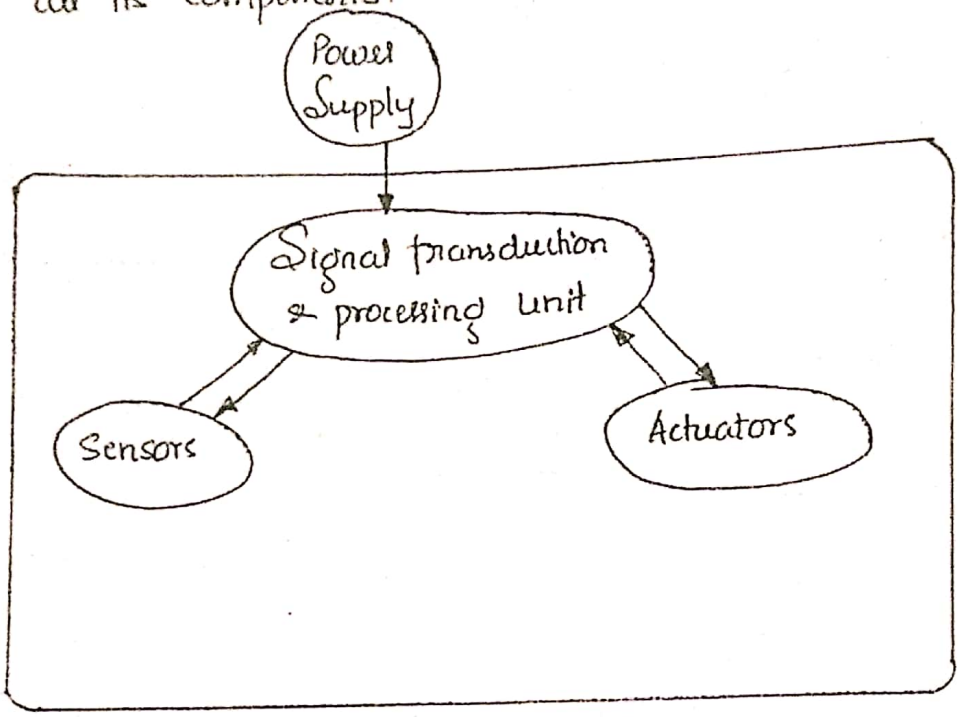
Academic Year: AUG'18 - DEC'18

SCHEME & SOLUTIONS

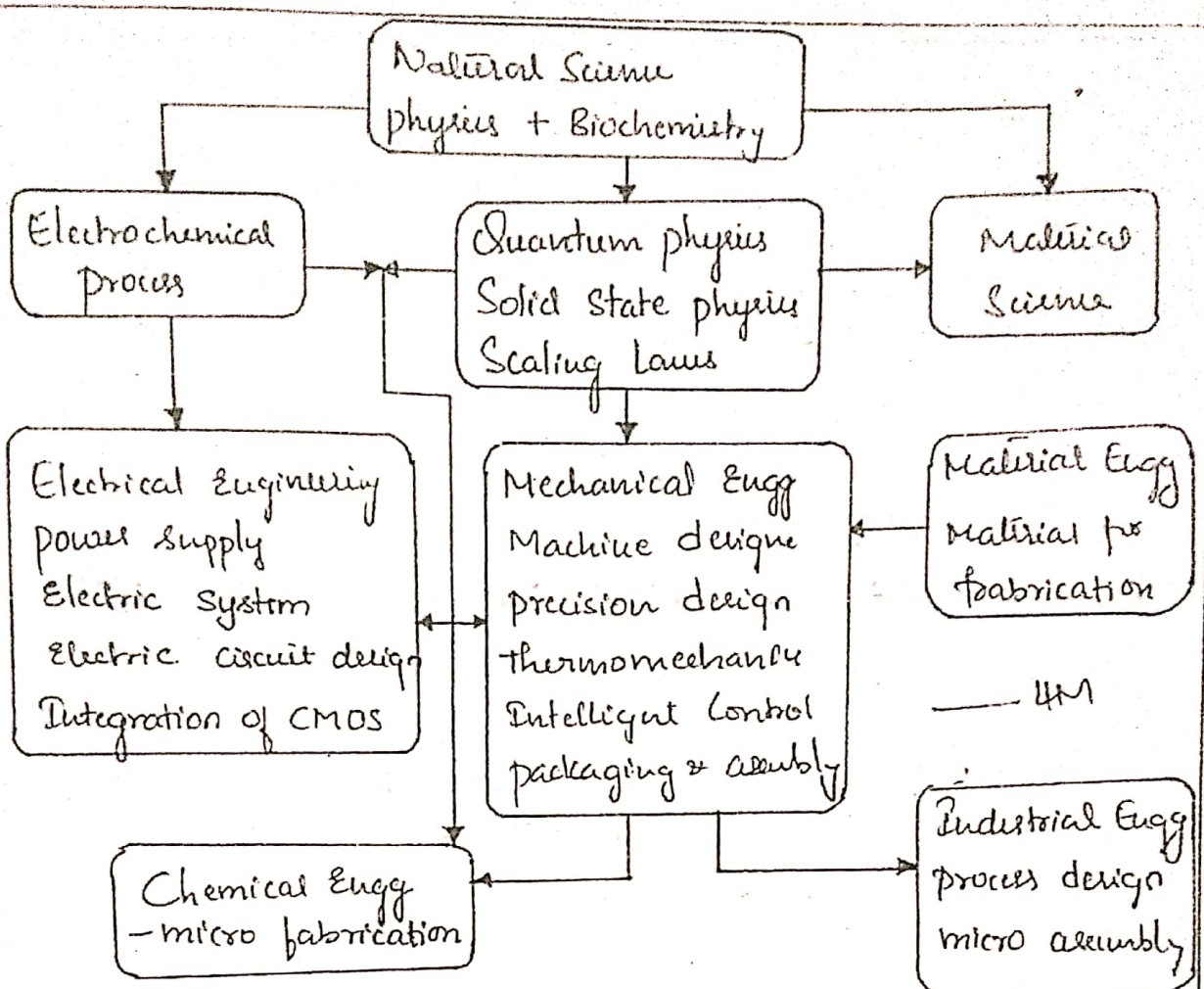
INTERNAL TEST – I(CBCS Scheme)

SUB CODE: 15MT54 DATE: 4 - 09 - 2018
SUB NAME: MICRO & SMART SYSTEM TECHNOLOGY MAX MARK: 40M
SEM: V DURATION: 1Hr 30Mins

Q. No		Marks
	PART – 1	
Q.1	Smart system :– smart system is system which integrates the properties of embedded sensors, actuators and controlled mechanisms in order to respond to a given stimulus in a functionally useful manner. this involves implementing of both hardware and software control mechanisms —2M schematic diagram of a smart system  —2M Explanation of working or function of each component a. Structure b. Sensor c. Controller d. Actuator e. Data base —4M	8M

Q. No		Marks
Q2	MICRO SYSTEMS: Explanation and definition of the micro system. 2M Schematic diagram of micro system. and explaining all its components.  4M Applications of microsystems (minimum 4 applications). 2M	8M
	PART- 2	
Q3	Miniaturization: Explanation of miniaturization. — 2M Requirement or need of miniaturization — 4M Example of miniaturization — 2m.	8M
Q4	Multidisciplinary aspects of microsystems Schematic diagram of multidisciplinary aspects.	

Q. No		Marks



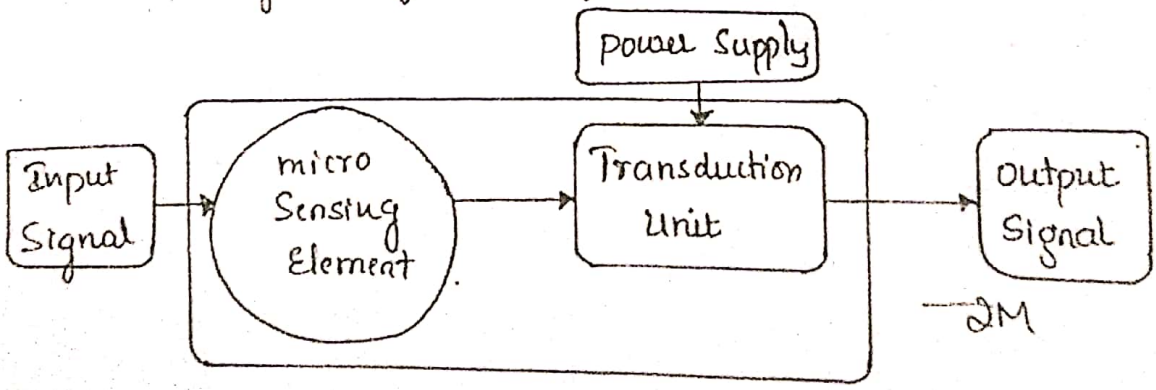
9M

Explanation of all different Science and Engineering aspects of microsystems and their applications — 4M

PART – 3

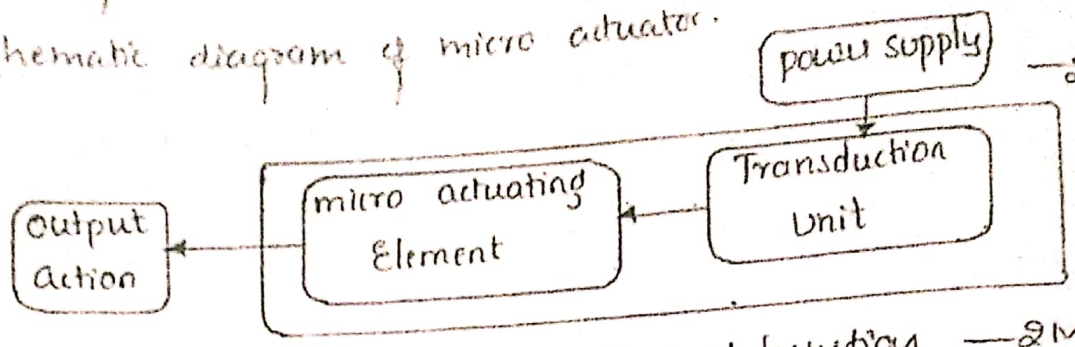
Q5. Micro system as micro sensor

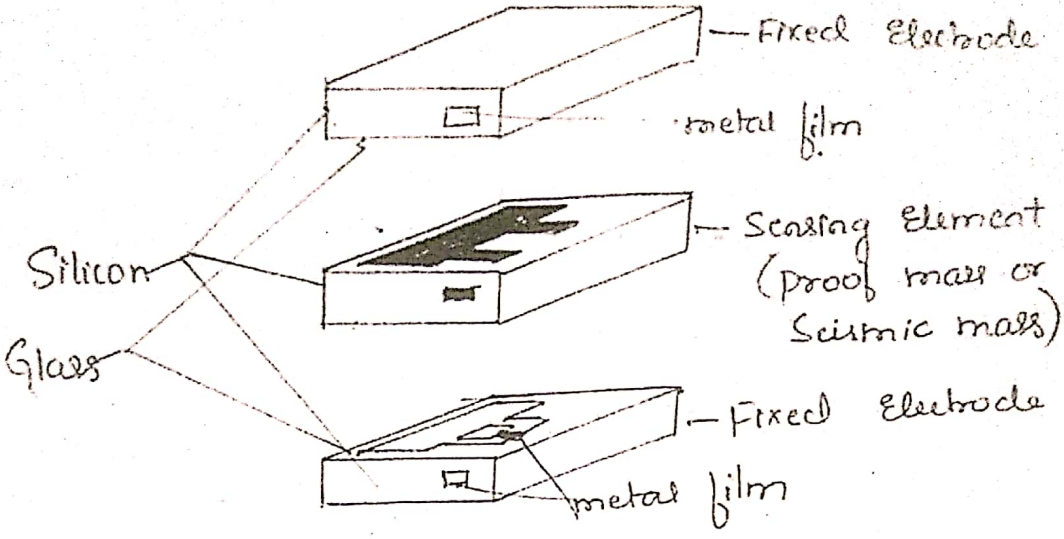
Schematic diagram of microsystem as micro sensor



— 2M

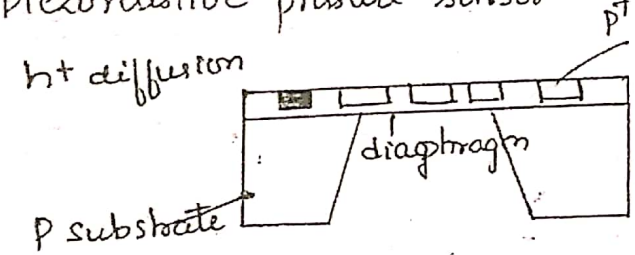
Explanation of Each Component — 2M

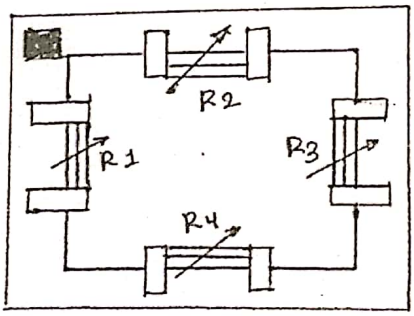
Q. No		Mark
	Microsystem as micro actuator Schematic diagram of micro actuator.  —2M Explanation of all components and function —2M	8M
Q6	Smart Materials :- Smart materials definition and Explanation. -2M Different type of smart materials (6 types) — 2M Explanation of any two type of smart materials — 4M	8M
	PART — 4	
Q7.	Sensors actuators Systems } Definition —3M Salient feature of sensors : Accuracy, precision, Resolution. Repeatability, reprodnicibility. Salient feature of actuators : Stress, Strain, Max actuation Stress, & Max actuation Strain } 5M Systems feature any 3 points	8M
Q8	Silicon Capacitive accelerometer Schematic diagram of Silicon Capacitive accelerometer.	

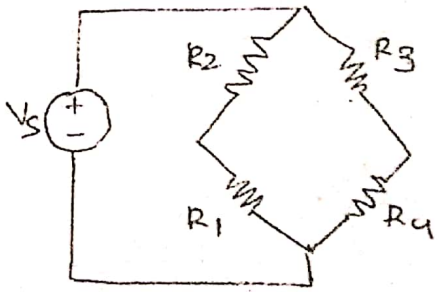
Q. No		Marks
	 Explanation of working of Silicon capacitive accelerometer ——5M	3M 8M

PART – 5

Q. 9. Piezoresistive pressure sensor



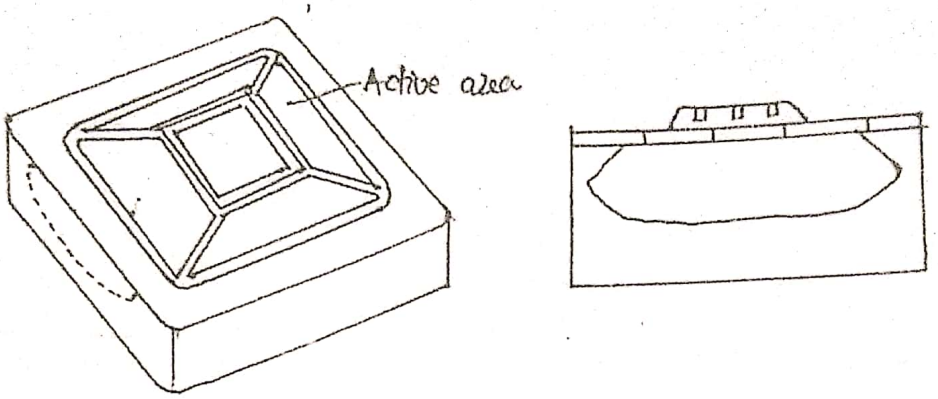




8M

Schematic diagram of piezoresistive pressure sensor — 3M

Explanation of working of the above Sensor —— 5M

Q. No		Marks
Q10.	Conductometric Gas sensor Schematic diagram of Conductometric Gas sensor  – 3M Explanation of working of conductometric Gas Sensor – 6M	– 3M

THE OXFORD COLLEGE OF ENGINEERING

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Academic Year: AUG 18–DEC 18

INTERNAL TEST –II(CBCS Scheme)

SUB CODE: 15MT54 DATE: 16.10.2018
SUB NAME: MICRO & SMART SYSTEM TECHNOLOGY MAX MARK: 40M
SEM: V DURATION: 1Hr 30Mins

Answer any one full questions from each Part **5x6 =30marks**

Q. No.	Part 1	Marks	COs,POs
Q1.	Explain the working principle of Piezo-electric based inkjet print head.	08	CO1,PO1
	OR		
Q2.	With the neat sketch explain electrostatic comb drive.	08	CO1,PO1
	Part 2		
Q3.	Explain the working principle of magnetic micro relay.	08	CO1,PO1
	OR		
Q4.	With neat sketch explain silicon wafer preparation.	08	CO2,PO1
	Part 3		
Q5	With neat sketch explain thermal oxidation for silicon dioxide.	08	CO2,PO1
	OR		
Q6.	Discuss the process of preparation of silicon dioxide, silicon nitride, polysilicon using chemical vapor deposition.	08	CO2,PO1
	Part 4		

Q7.	With the necessary sketches, explain the key processes involved in photolithography.	08	CO3,PO1
	OR		
Q8.	Explain surface micromachining to realize a cantilever structure with neat pictorial representations.	08	CO4,PO1
	Part 5		
Q.9.	With the help of neat sketch explain various steps involved in liftoff technique.	08	CO5,PO1
	OR		
Q.10.	What is etching process and Explain (i) Dry etching (ii) Wet etching (iii) Isotropic etching	08	CO6,PO1

Course Outcomes

Students will be able to

1.	Know different types of actuators in the applications of microstructures.
2.	Know the materials which are used in fabrication of Microsystems.
3.	Understand the processes for the manufacturing of Microsystems active parts.
4.	Know the processes involved in the surface micromachining.
5.	Understand the manufacturing of the thin film.
6.	Know how the base structures in the Microsystems are produced by micromachining.

Faculty Signature

for H.Rayji
HOD Signature

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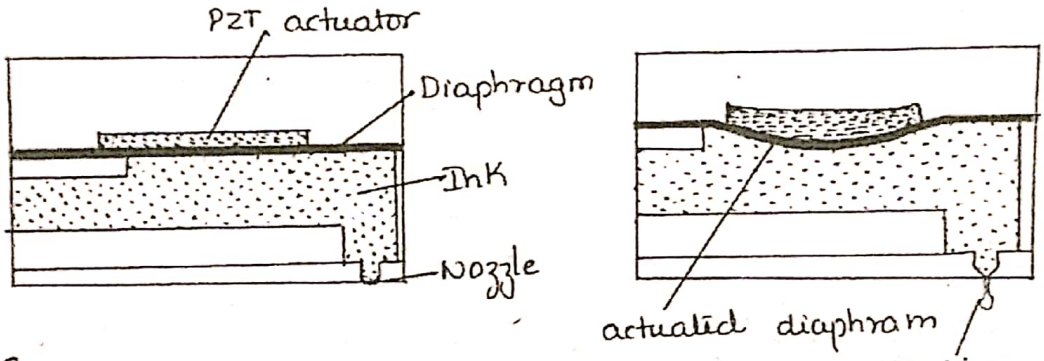
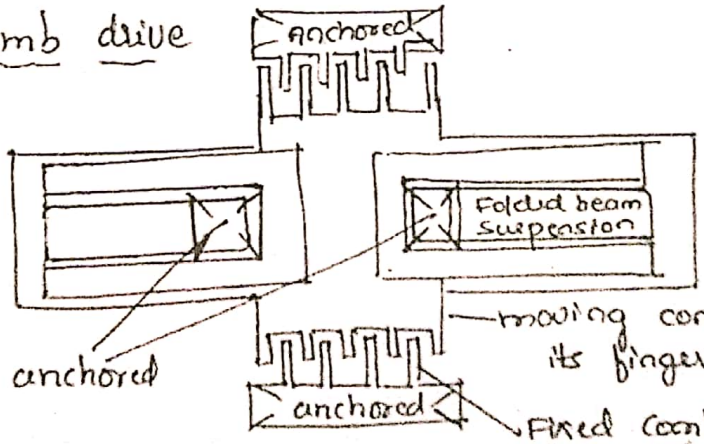
Academic Year: AUG'18 - DEC'18

SCHEME & SOLUTIONS

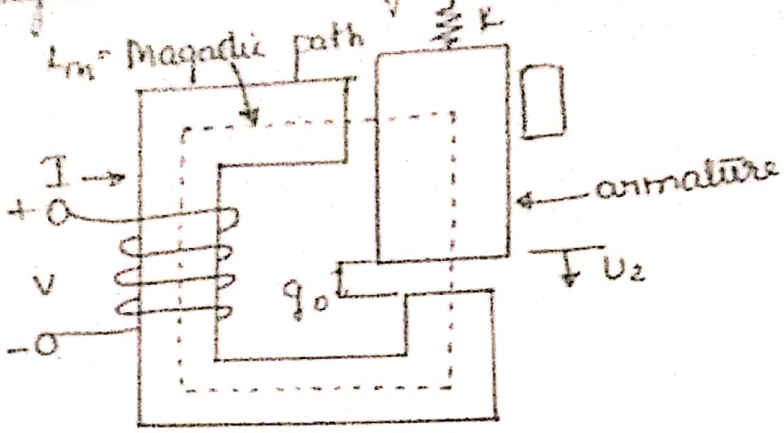
INTERNAL TEST – II (CBCS Scheme)

SUB CODE: 15MT54 **DATE:** 16.10.2018
SUB NAME: MICRO & SMART SYSTEM TECHNOLOGY **MAX MARK:** 40M
SEM: V **DURATION:** 1 Hr 30 mins

Q. No		Marks
	PART – 1	
Q1.	Piezo – electric based inkjet print head  Schematic diagram of piezo-electric based inkjet print head. ——— 3M Explanation of working of piezo electric inkjet print head. ——— 5M	8M
Q2	Electrostatic Comb drive  Schematic diagram of Electrostatic comb drive ——— 3M Explanation of working of Electrostatic comb drive — 5M	8M

Q3

Magnetic micro relay



Schematic diagram of magnetic micro relay – 2M

Explanation of magnetic micro relay – 6M

Q4

Silicon wafer preparation.

Explanation of Silicon as wafer material – 2M

working (or) preparation flow diagram with explanation – 6M

SiO_2 | Quartz

↓

Refining – arc furnace

90 - 99% pure Silicon

↓

metallurgical Grade Silicon

↓ HCl

Trichlorosilane $SiHCl_3$

↓

Fractional distillation in H. in atm.

↓

EGS

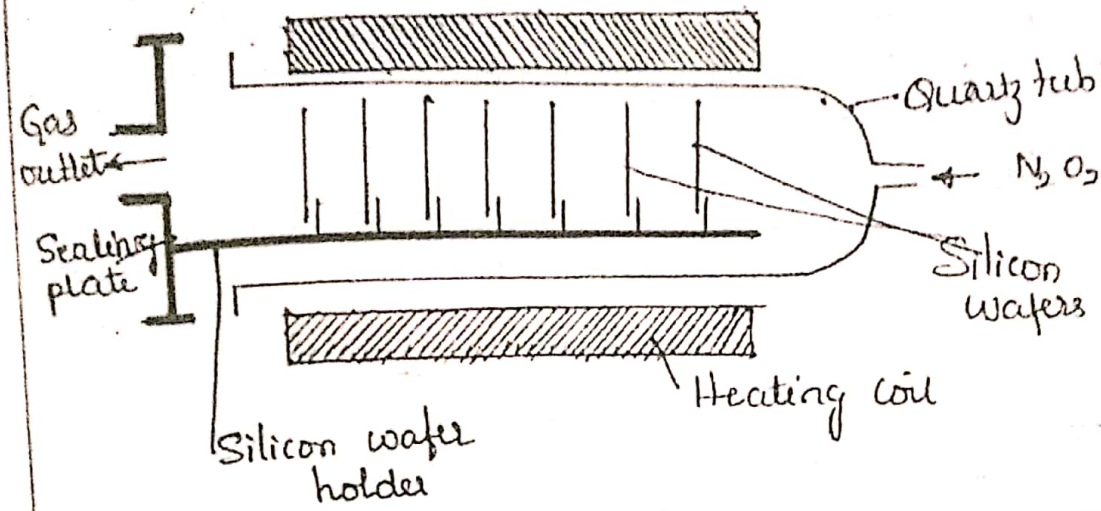
↓

SCS

↓ Slicing

Silicon wafers

Q. No		Marks
	PART- 3	
Q5.	Thermal oxidation for Silicon dioxide	



-3M

Schematic diagram of Thermal oxidation process —3M

Explanation of the process with chemical reactions involved

$$Si + 2H_2O \xrightarrow{900 \text{ to } 1200\,^\circ C} SiO_2 + 2H_2 \quad \text{(wet oxidation)}$$

$$Si + O_2 \longrightarrow SiO_2 \quad \text{(Dry oxidation)}$$

— 5M

Q6.	Silicon dioxide preparation Explanation with chemical reactions involved.	

$$SiH_4 + O_2 \xrightarrow{400 \text{ to } 500\,^\circ C} SiO_2 + 2H_2$$ — 3M

$$SiCl_2H_2 + 2H_2O \longrightarrow SiO_2 + 2H_2 + 2HCl$$

Silicon nitride preparation

Explanation with chemical reactions involved — 3M — 8M

$$3\,SiH_4 + 4NH_3 \xrightarrow{700 \text{ to } 900\,^\circ C} Si_3N_4 + 12\,H_2$$

$$3\,SiCl_4 + 4NH_3 \xrightarrow{800\,^\circ C} Si_3N_4 + 12\,HCl$$

$$3\,SiH_2Cl_2 + 4NH_3 \xrightarrow{650\,^\circ C \text{ to } 750\,^\circ C} Si_3N_4 + 6\,HCl + 6H_2$$

Q. No

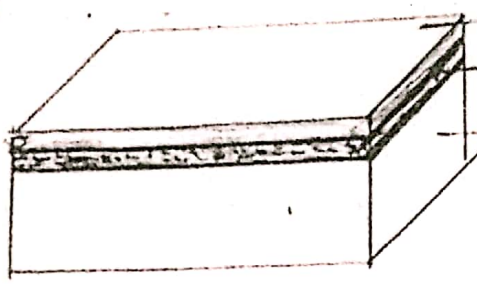
Physical preparation using chemical vapor deposition
Explanation with chemical reaction

SiH_4 ——— 600 to 650°C ——→ $2H_2$

PART – 4

Q3 PHOTOLYTHOGRAPHY

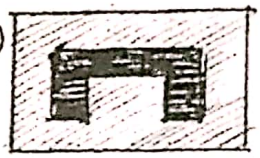
Start wafer with oxide thin film (a) resist coated on it

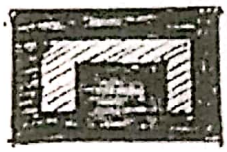


mask plate with image (b)

— mask plate pattern

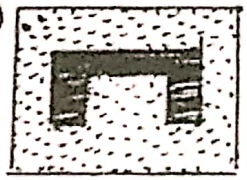
after exposure (c)

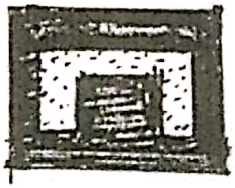




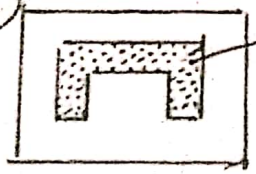
4 M

After developing (d)

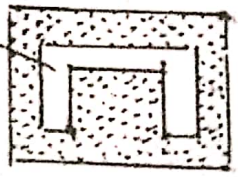




After removal (Stripping of resist) (e)



Transformed pattern on plate



Explanation of working in photolythography with Steps involved

1. Resist Coating
2. Prebaking
3. UV exposure
4. Developing
5. postbaking
6. Etching
7. photoresist Stripping

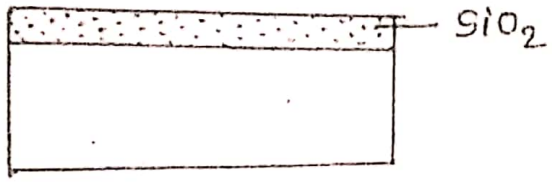
} 4M

Q.No | Marks

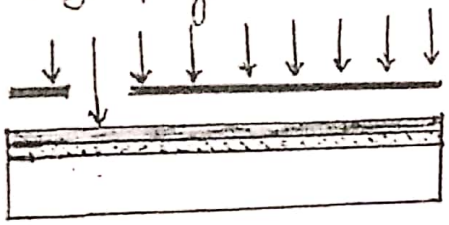
Surface micromachining to realize a Cantilever Structure

Sch pictorial representation of surface micromachining to realize Cantilever Structure.

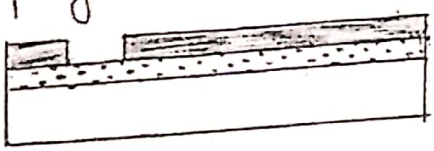
(a). deposit SiO_2 on Si wafer



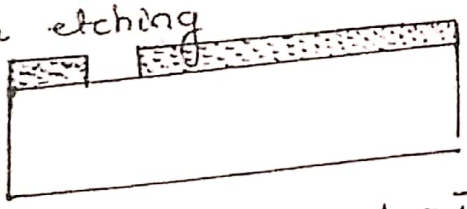
(b) UV Lithography



(c) Developing

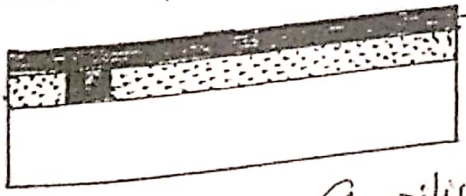


(d) Oxide etching

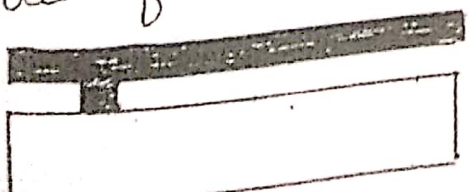


4M

(e) polysilicon deposition and patterning



(f) removal of oxide (Sacrificial layer)



4M

Explanation of each steps in Surface micromachining 4M

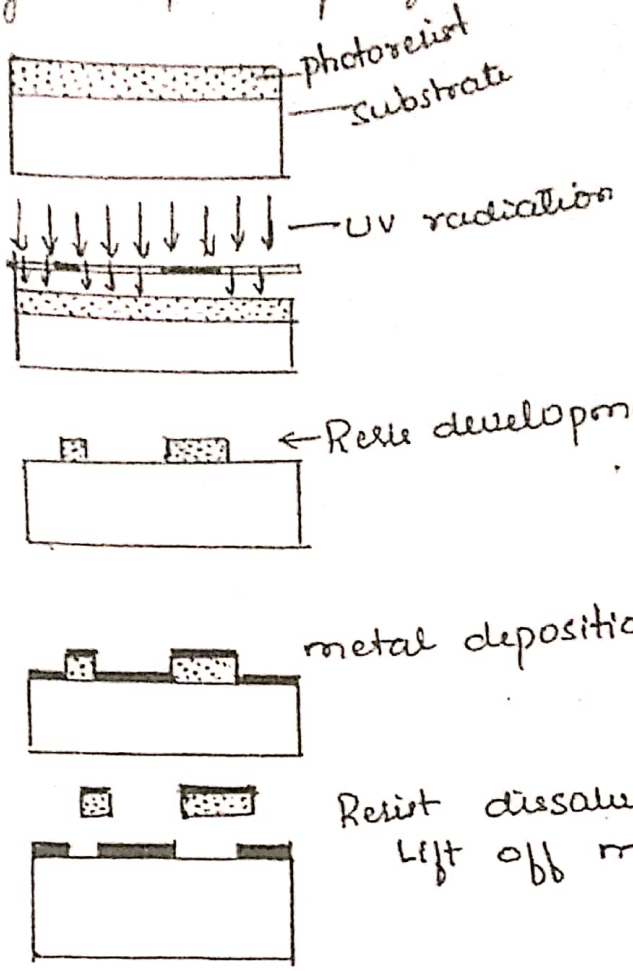
8M

Q. No		Marks

PART 5

Q.9 LIFT OFF TECHNIQUE

Schematic diagram representing Lift off technique Steps



3M

3M

Explanation of lift off technique with each steps — 5M

Q.10. Etching process :- Explanation of etching process — 2M
diff types of Etching process

i) Dry etching process — explanation — 2M
ii) Wet etching process — Explanation — 2M
iii) Isotropic etching process - Explanation - 2M.

8M

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Academic Year: AUG 18–DEC 18

INTERNAL TEST – III (CBCS Scheme)

SUB CODE: 15MT54 DATE: 23.11.2018
SUB NAME: MICRO & SMART SYSTEM TECHNOLOGY MAX MARK: 40M
SEM: V DURATION: 1Hr 30Mins

Answer any one full questions from each Part 5x6 =30marks

Q. No.	Part 1	Marks	COs, POs
Q1.	With the neat sketch explain enhanced MOFSET with VI characteristics.	08	CO1,PO1
	OR		
Q2.	Briefly explain the different OP-Amp based circuits.	08	CO1,PO1
	Part 2		
Q3.	Explain the vibration control of beams in micro systems using neat sketch.	08	CO1,PO1
	OR		
Q4.	Define Bulk micro machining. With the flow chart explain it.	08	CO2,PO1
	Part 3		
Q5	Explain the VI characteristics of BJT along with construction.	08	CO4,PO1
	OR		
Q6.	Explain instrumentation Amplifier as a differential voltage amplifier.	08	CO3,PO1
	Part 4		
Q7.	Explain Analog to Digital converter.	08	CO3,PO1
	OR		
Q8.	Explain phase-locked loop, with a neat block diagram.	08	CO3,PO1
	Part 5		

Q.9.	Reliability and key failure mechanisms in Microsystems.	08	CO5,PO1
	OR		
Q.10.	Elucidate the characteristics and performance parameters of pressure sensor.	08	CO6,PO1

Course Outcomes

Students will be able to

1.	Understand the electronic circuits and control of MEMS
2.	Understand the working methodology of micro-machining.
3.	Understand the different circuits to control the micro systems.
4.	Know the different electronics devices to control MEMS.
5.	Understand drawbacks of micro systems by thier failure mechanisms.
6.	Know the characteristics & performance parameters of pressure sensors.

Faculty Signature

HOD Signature

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Academic Year: AUG'18 - DEC'18

SCHEME & SOLUTIONS

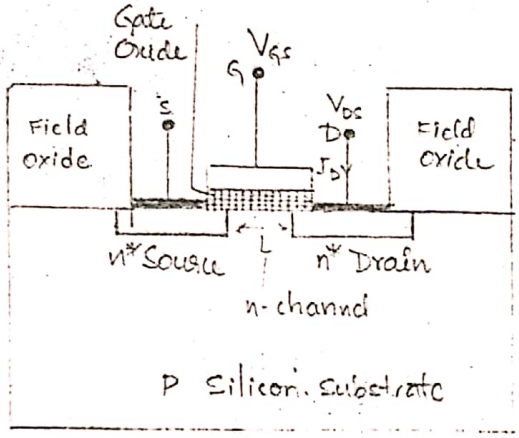
INTERNAL TEST – II (CBCS Scheme)

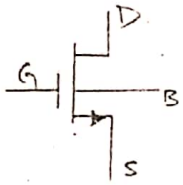
SUB CODE: 15MT54 DATE: 23 - 11 - 2018
SUB NAME: MICRO & SMART SYSTEM TECHNOLOGY MAX MARK: 40M
SEM: V DURATION: 1Hr 30 Min

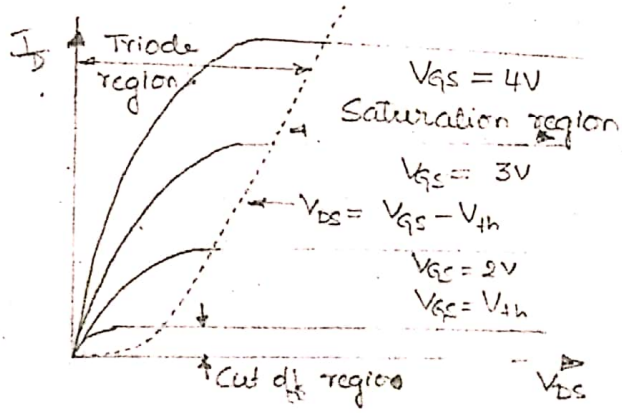
Q. No		Marks

PART — 1

Q1. MOFSET with VI characteristics







8M

Schematic diagram of n-channel MOSFET

Explanation of MOSFET with its different parameters and types of MOSFET and its operation.

VI characteristics of MOSFET :—

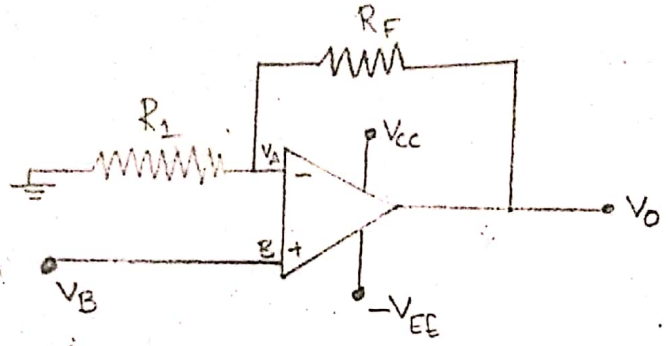
i) Cut-off Region
ii) Triode Region
iii) Saturation region.

OR

Q2 OP-Amp based Circuits

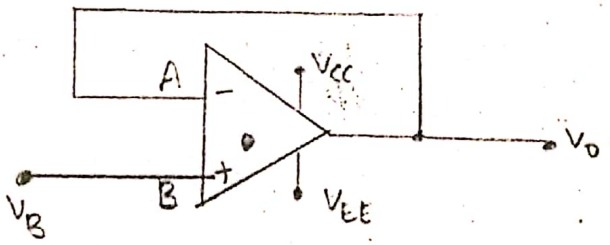
Explanation of different types of OP-Amp based Circuits

(i) Non - Inverting amplifiers

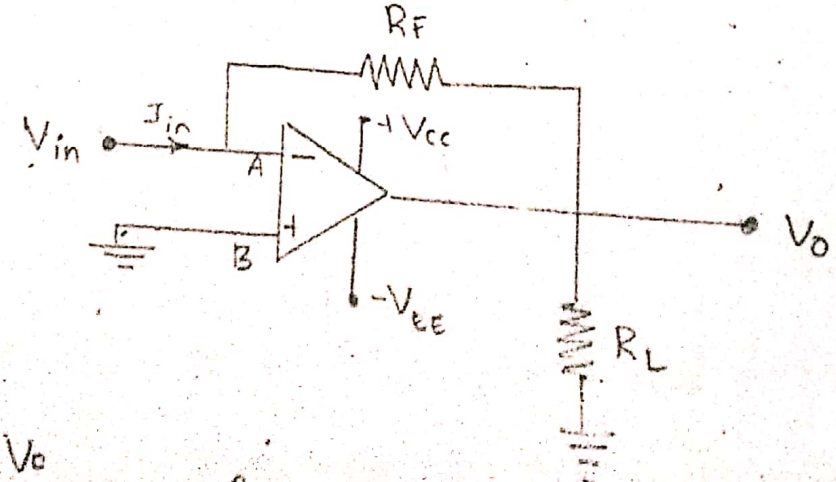


$$\frac{V_o}{V_{in}} = \frac{R_1 + R_2}{R_1} = 1 + \frac{R_2}{R_1}$$

(ii) Voltage - follower



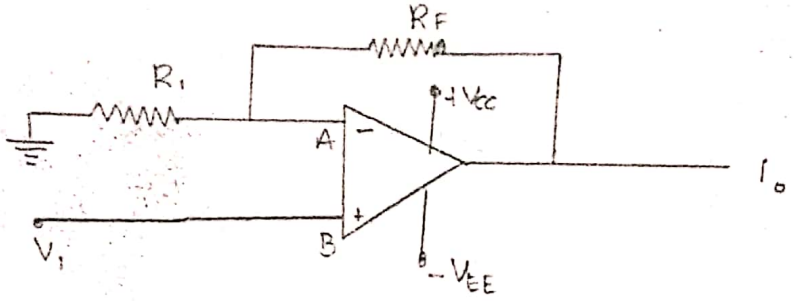
(iii) Transimpedence amplifier



$$\frac{V_o}{V_{in}} = -I_{in} R_F$$

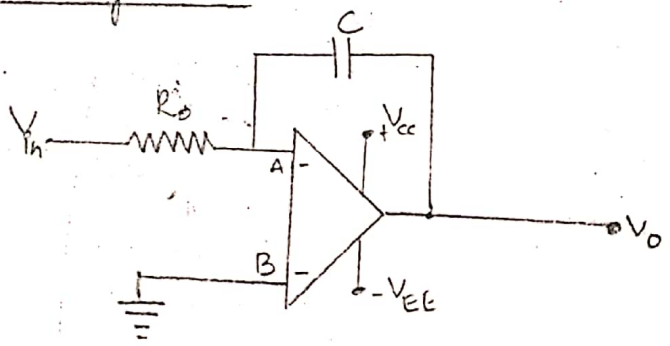
Q. No		Marks

(iv) Transconductance amplifier



$$I_o = \frac{V_B}{R_1}$$

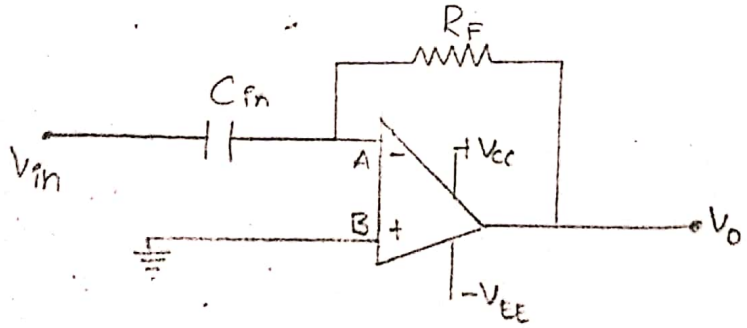
(v) Integrator



4M

$$V_o = -\frac{1}{RC}\int V_{in}(t)\,.\,dt$$

(vi) Differentiator

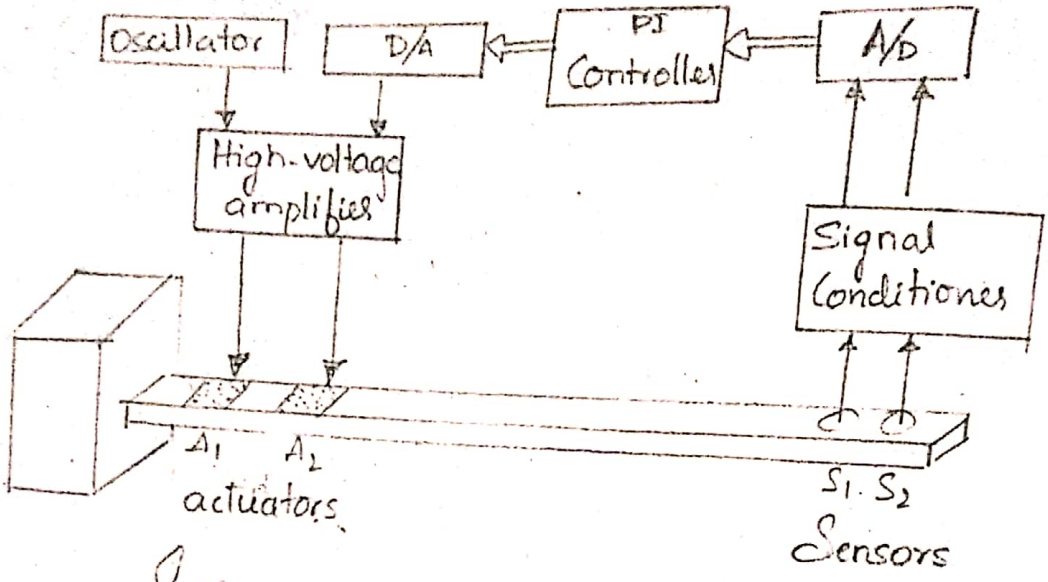


$$V_o = RC_{in}\cdot\frac{dV_{in}}{dt}$$

Q. No

PART – 2

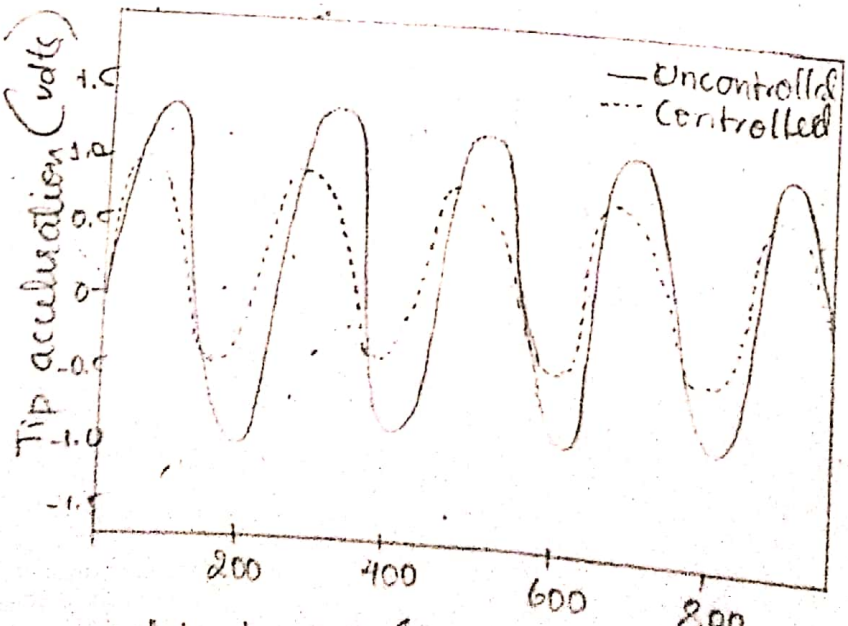
Q3. Vibration Control of beams in microsystems



Schematic diagram of Control System.

Explanation of vibration control of beams in microsystems.

Experimental results showing the response of the sensor with and without the PI controller.



Q. No		Marks

OR

8M

Q4. Bulk micro-machining

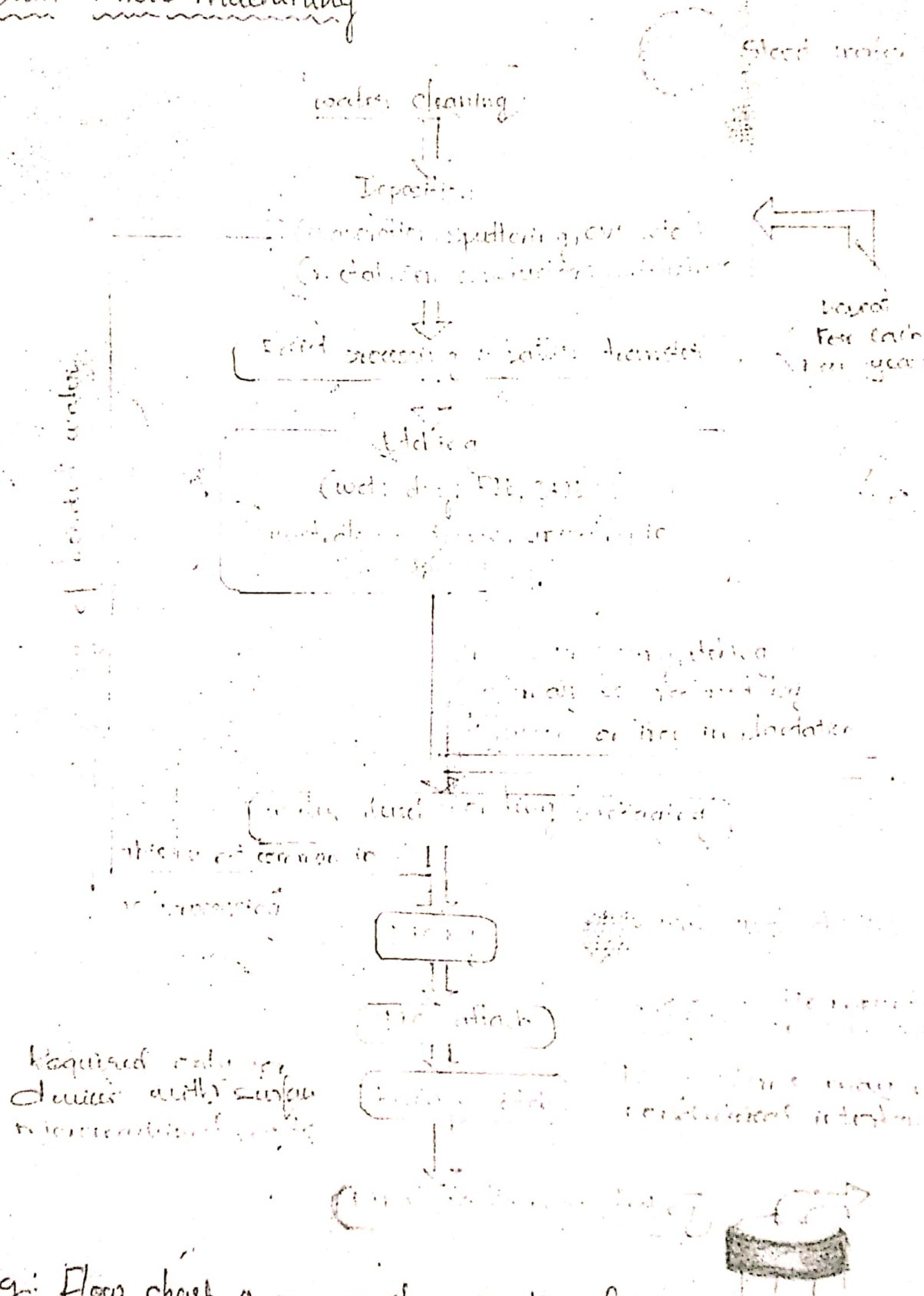


Fig: Flow chart of process steps in the fabrication of microsystems.

Explanation of Bulk micromachining with operation.

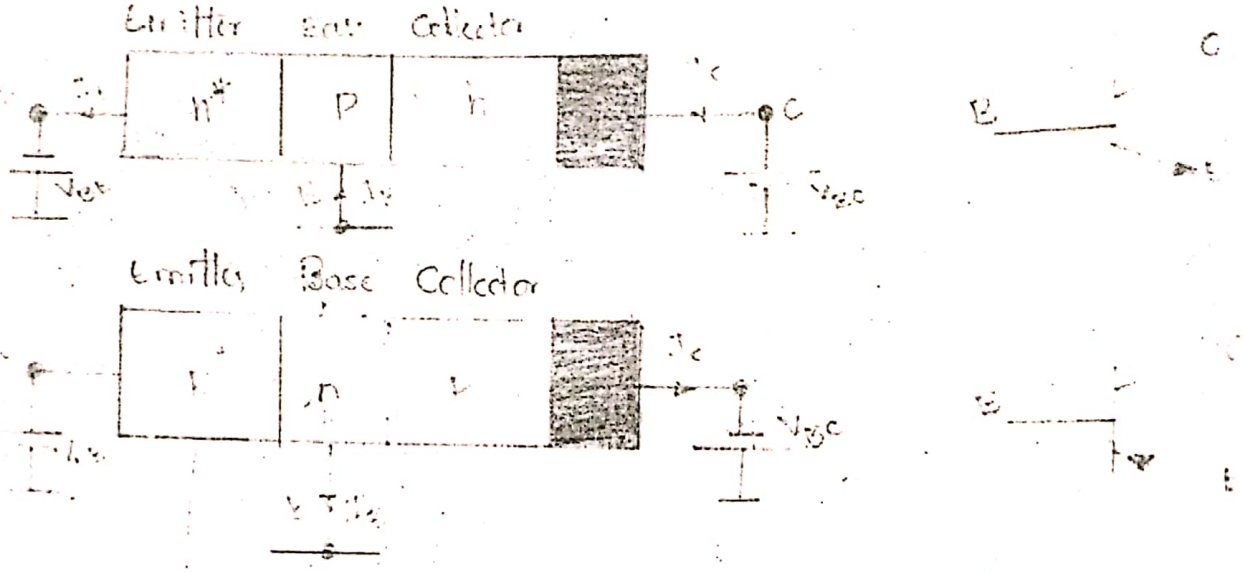
Q. No

PART – 3

Q5

VI characteristics of BJT along with Construction.

The bipolar junction transistor is a three-terminal semiconductor device which finds wide applications for amplifying or switching applications in microelectronics.



Basic structure of (a) an open & (b) a pnp bipolar junction transistor. parts (c) and (b) are the circuit symbols for parts (a) and (b) respectively.

The Output characteristic of BJT connected as in fig b

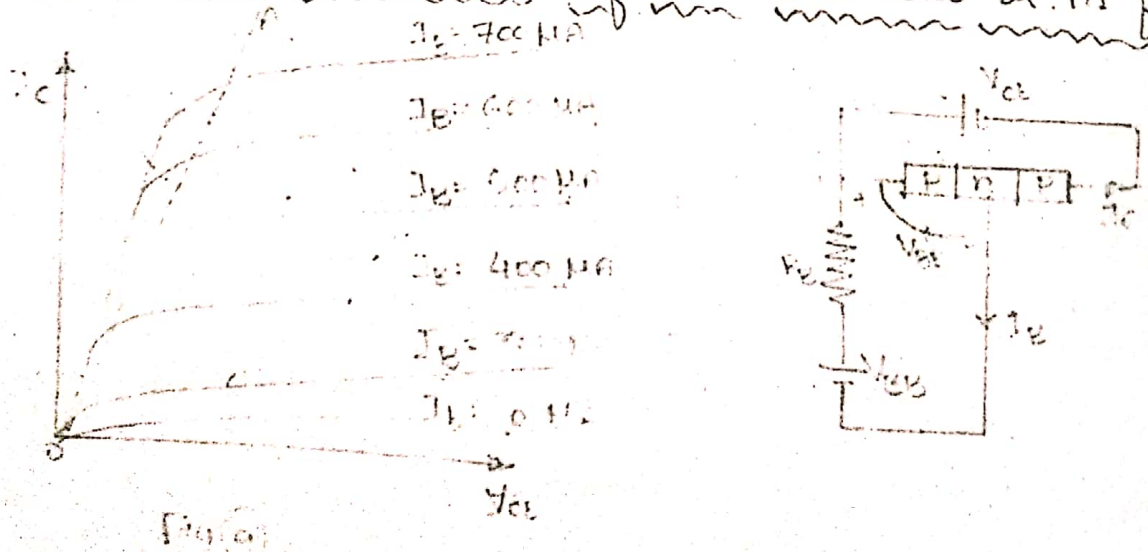


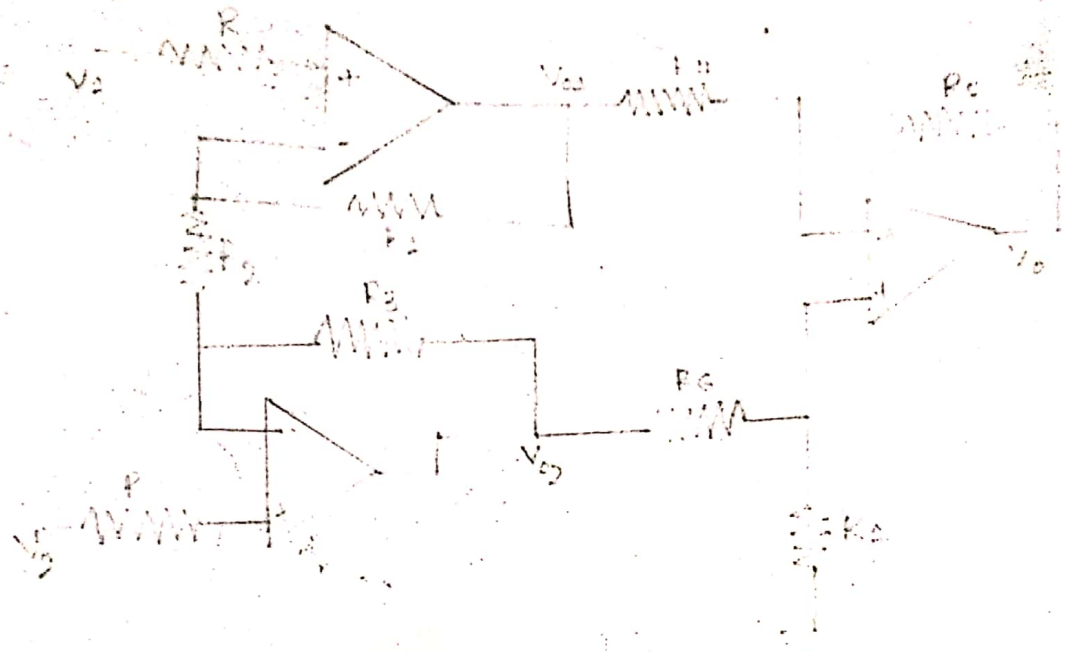
Fig (a)

Fig (b)

Explanation of construction of BJT.

Marks

9.6. Instrumentation Amplifier as a differential voltage amplifier



8M

Explanation of working of Instrumentation Amplifier as a differential voltage amplifier.

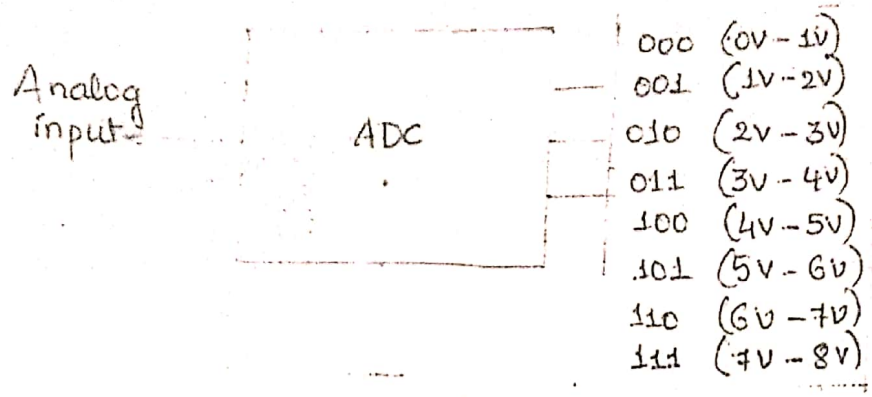
$$\frac{V_0}{V_2 - V_1} = \left(1 + \frac{2R_1}{R_2}\right)\frac{R_5}{R_4}$$

PART — 4

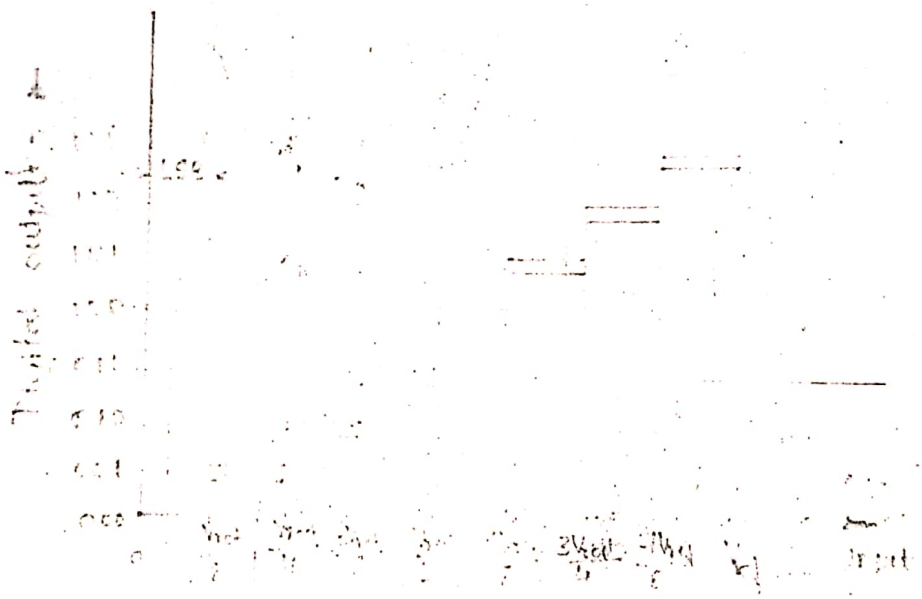
10. ANALOG TO DIGITAL CONVERTER:

The output signals of most physical systems (such as temperature & pressure gauges, flow transducers) are analog or continuous functions of time. However these functions signals must be converted into binary form to enable processing in the digital domain & take advantage of their efficiency & Reliability. The circuit performs this conversion is called an analog to digital converter

Q. No



Three - bit ADC input/output scheme.



(a) Digital output

8. PHASE LOCKED LOOP

The phase-locked loop (PLL) is one of the basic building blocks of electronic circuits used in several applications such as motor-speed controllers, filters, frequency-synthesized transmitters, receivers & microsystems. As illustrated in Fig (a) the PLL consists of a phase detector, a low pass filter (LPF), dc amplifier & a voltage-controlled oscillator (VCO).

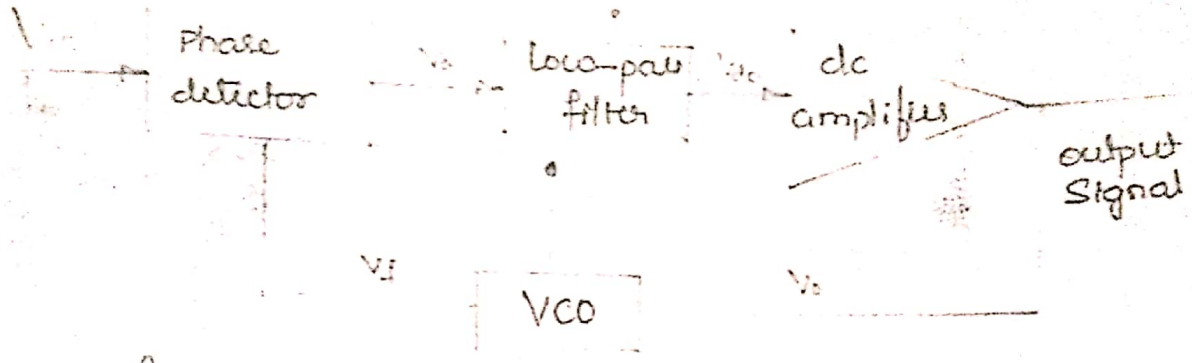
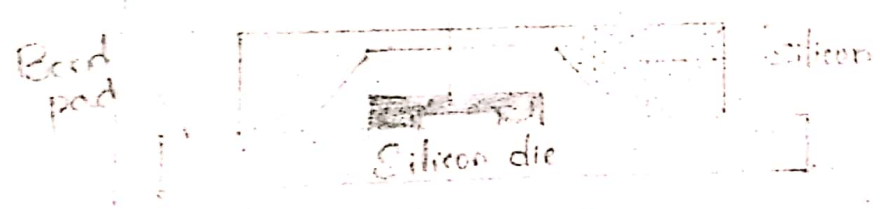


fig: Block diagram showing the operating principle of a PLL.

PART – 5

9. Reliability & key failure mechanisms in microsystems

Reliability Studies and mechanism of failure



The understanding of reliability of systems comes from the knowledge of its failure behaviors & the failure mechanisms. The Common failure mechanisms of microsystems are as follows. 2M

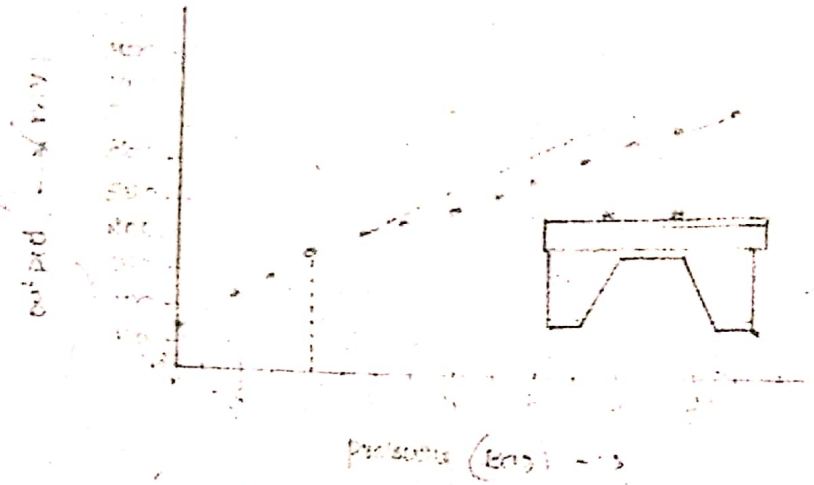
(Explanation of following terms).

1. Striction (Explaination)
2. Wear (Explaination)
3. Delamination (Explaination)
4. Damping (Explaination)
5. Fatigue (Explaination)
6. Mechanical Failure (Explanation).

Q. No | Marks

Q 10. Characteristic & performance parameter of pressure sensor.

Typical characteristic of pressure sensor



Explanation of the following

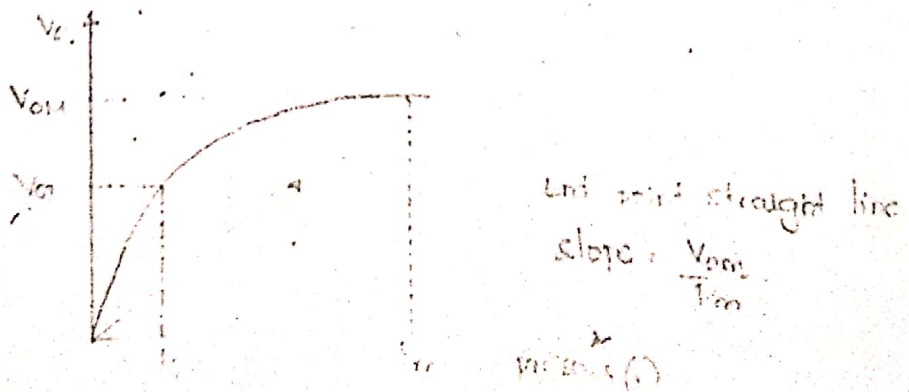
(1) Sensitivity (S) 8M

$$S = \frac{\Delta V_o}{\Delta p}\frac{1}{V_{IN}} = \frac{\Delta R}{\Delta p}\frac{1}{R}$$

(2) Offset voltage (V_{OFF})

$$NL_f = \frac{V_{01} - (V_{OM}/P_m)P_i}{V_{OM}} \times 100\ \%$$

(3) Non linearity in piezoresistive pressure sensor.



MICRO AND SMART SYSTEMS TECHNOLOGY (15MT54) QUESTION BANK

MODULE 1

1. What are smart systems? Explain the components of a smart system with the help of a block diagram.
2. Mention the applications of smart materials and microsystems.
3. What is miniaturization? Mention the need and advantages of miniaturization of systems.
4. With the help of a neat block diagram explain the multidisciplinary nature of micro system.
5. What are micro systems? Explain the components of micro system along with the applications.

MODULE 2

1. Explain sensors, actuators, and systems with their salient features.
2. What are sensors, and explain the working principle of silicon capacitive accelerometer with diagram.
3. Explain working principle of piezoresistive pressure sensor.
4. With a short note on portable blood analyzer.
5. Explain micro system as micro sensor and micro actuator with block diaram.
6. Explain various blocks in typical smart system and compare each composnents of system with that of a biological system.
7. What are smart materials, mention differernt types of smart materials, explain working principle of any two smart materials.
8. Explain micro sensors and micro actuators.
9. Explain the working principle of peizp-electric based inkjet print head, magnetic micro relay, magnetic micro relay, electrostatic comb drive.
10. With the neat sketch explain the silicon micro mirror array used for video projection.

MODULE 3

1. With neat sketch explain silicon wafer preparation.
2. What do you mean by thin film deposition? Mention the differerent types of thin film deposition? Explain any one.
3. What is lithography? Explain with neat sketch photo lithography/

4. Explain the sputtering and chemical vapor deposition technique, with neat diagram and equations.
5. Explian the different types of etching with relevant diagrams, chemical equations and etchants.
6. Explain surface micromachining to realize a cantilever structure with neat pictorial representations.
7. Define etch stop? Briefly explain the different methosds used to stop etching.
8. With th help of neat sketch explain various steps involoved i9n lift off technique.
9. Wrote a short note on the following (i) Dry etching (ii) Wet etching (iii)Isotropic etching (iv) Anisotropic etching
10. Differentiate between positive photoresist and negative photoresist.

MODULE 4

1. With the neat sketch explain enhanced MOSFET with VI characteristics.
2. Briefly explain the different Op-Amp Based circuits.
3. With the neat circuits diagram explain intergration of MOSFET with pressure sensor.
4. Explain the vibration control of beams in microssystems with neat sketch
5. Explain the VI characteristics of BJT along with comstructions.
6. Define the bulk micromcabining. With the flow chart explain it/

MODULE 5

1. Explain the bulk microchined accelerometer.
2. Explain the instrumentation amplifiers as differentioal voltage amplifier.
3. Explain phase locked loop with a neat block diagram
4. Reliability and key failure mechanisms and performace parameters of pressure sensor.
5. Explain basic Op Amp circuits and their applications.
6. Explain analog to digital converter.

MICRO AND SMART SYSTEMS TECHNOLOGY

Assignment-1

1. What are smart systems? Explain the components of a smart system with the help of a block diagram.
2. Mention the applications of smart materials and micro systems.
3. What is miniaturization? Mention the need and advantages of miniaturization of systems.
4. With the help of a neat block diagram explain the multidisciplinary nature of micro system.
5. What are micro systems? Explain the components of micro system along with the applications.
6. Explain sensors, actuators, and systems with their salient features.
7. What are sensors and explain the working principle of silicon capacitive accelerometer with diagram.
8. Explain working principle of piezo-resistive pressure sensor.
9. With a neat sketch explain conductometric gas sensor.
10. Write a short note on portable blood analyzer.
11. Explain micro system as micro sensor and micro actuator with block diagram.
12. Explain various blocks in typical smart system and compare each components of system with that of a biological system.
13. Make a comparison between micro electronics and micro system technologies.
14. Mention the technical reasons for process of miniaturization.
15. What are smart materials, Mention different types of smart materials, explain working principle of any two smart materials.
16. Explain micro sensors and micro actuators.

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10EC752

Seventh Semester B.E. Degree Examination, Dec.2014/Jan.2015
Micro & Smart System Technology

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. What is microsystem? Make a comparison between micro electronics and micro systems. (08 Marks)

b. Explain the typical smart system with a block diagram. (08 Marks)

c. Mention the technical reasons for miniaturization. (04 Marks)

2 a. Explain with a neat diagram the process steps involved in the construction of silicon capacitive accelerometer and state principle of operation. (12 Marks)

b. Explain the principle of operation of DMD chip. (08 Marks)

3 a. With the help of neat sketches explain the process steps involved in realizing a cantilever structure by surface micro machining. (12 Marks)

b. Define etch stop? Briefly explain the different methods used to stop etching. (08 Marks)

4 a. For a straight beam in pure bending, show that the bending stress σ_x, the bending moment M and area moment of inertia I are related by, $\sigma_x = \frac{M}{I} y$. (10 Marks)

b. Explain various scaling issues to be considered in miniaturization. (10 Marks)

PART – B

5 a. Explain the need for using numerical methods in micro system design. (10 Marks)

b. Derive the shape function for a rod of finite element having length L and axial rigidity EA. (10 Marks)

6 a. Explain with a neat schematic how to measure capacitance or charge from switched capacitor circuits. (10 Marks)

b. Describe a role of implementing a PID controller for a smart system design. (10 Marks)

7 a. Briefly explain the different types of microsystem packages. (10 Marks)

b. Explain the reliability and key mechanism that are essential in micro system. (10 Marks)

8 Write short notes on the following:

a. Active vibration control.

b. Finite element method.

c. Thin film deposition.

d. Soft lithography. (20 Marks)

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10EC752

Seventh Semester B.E. Degree Examination, Dec.2015/Jan.2016
Micro and Smart Systems Technology

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART - A

1 a. Discuss the applications of Micro system in the Aerospace Industry. (06 Marks)
b. With the help of a neat block diagram, explain the multidisciplinary nature of micro system design and manufacturing. (10 Marks)
c. Discuss evolution of micro fabrication. (04 Marks)

2 a. Explain the principle of operation of Silicon Capacitive Accelerometer, with a neat diagram. (06 Marks)
b. Discuss in digital Piezoresistive pressure sensor, with a schematic diagram. (06 Marks)
c. Write short note on Magnetic Micro relay. (04 Marks)
d. Explain the principle of operation of Portable Blood Analyzer. (04 Marks)

3 a. Explain Czochralsk method for growing Single – Crystal Silicon. (06 Marks)
b. Discuss the process of preparation of Silicon Dioxide, Silicon Nitride and Polysilicon using Chemical Vapor Deposition. (08 Marks)
c. With the help of a neat diagram, explain the different process steps involved in the fabrication of micro system. (06 Marks)

4 a. With the help of appropriate equations, discuss scaling dynamic forces. (04 Marks)
b. Discuss the effect of Residual Stress Gradient on a Cantilever beam. (06 Marks)
c. Using FEM (Finite Element Method) analyze a stepped bar. (10 Marks)

PART - B

5 a. Discuss the analysis of Piezoelectric Bimorph Cantilever Beam using Finite Element Method. (10 Marks)
b. Discuss the dynamics of the Simplest Lumped Electro Mechanical Method. (10 Marks)

6 a. Explain Instrumentation Amplifier as a Differential Voltage Amplifier. (06 Marks)
b. Explain Phase – Locked Loop, with a neat block diagram. (06 Marks)
c. With appropriate mathematical equations, explain State – Space Modeling. (08 Marks)

7 a. Discuss the special issues in Micro system packaging. (06 Marks)
b. Briefly explain various types of micro system packages. (06 Marks)
c. With the help of a neat diagram, explain Die – Level Packaging in detail. (08 Marks)

8 a. With appropriate equations, discuss the various design considerations of Piezoresistive Pressure sensor. (10 Marks)
b. Explain active vibration control in beams using Lead Zirconate Titanate Transducers. (10 Marks)

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10EC752

Seventh Semester B.E. Degree Examination, June/July 2017
Micro and Smart System Technology

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Explain the various blocks in typical smart system and compare each component of with that of a biological system. (10 Marks)

b. Make a comparison between micro electronics and Microsystems technologies. (05 Marks)

c. Mention the need and advantages of miniaturization of machine and devices. (05 Marks)

2 a. With necessary sketches, explain the working principle of silicon capacitive accelerometer and mention its advantages and applications. (08 Marks)

b. Briefly explain the following :
i) Magnetic micro-relay ii) Piezo-electric inkjet actuator. (12 Marks)

3 a. With necessary sketches, explain the key processes involved in photolithography. (10 Marks)

b. With the help of neat sketches, explain various steps involved in lift-off technique. (10 Marks)

4 a. With the help of neat sketches, explain the various steps involved in the fabrication of a cantilever structure by surface micromachining. (10 Marks)

b. Explain the Anode bonding process for microfabrication.. (05 Marks)

c. Explain various scaling issues to be considered in miniaturization. (05 Marks)

PART – B

5 a. What is Finite element method? Briefly explain its procedure using flow-chart. (10 Marks)

b. Obtain an expression for the stresses developed in a two-bar assembly of stepped bar with fixed ends. (10 Marks)

6 a. With a neat schematic of instrumentation amplifier, mention its characteristics and obtain expression for its differential gain. (10 Marks)

b. With necessary schematics and waveforms, explain the operation of switched capacitor circuit for capacitance measurement. (10 Marks)

7 a. Design an inverting amplifier with closed loop voltage gain -100 and feedback resistance of 100kΩ. Also find its output voltage for a input voltage of 0.5μV. (06 Marks)

b. Briefly explain the various possibilities of monolithic integration of CMOS and microsystem. (09 Marks)

c. Mention the general considerations in packaging design. (05 Marks)

8 Write a short note on the following :
a. Isotropic etching
b. Dry etching
c. Wire bonding
d. LIGA process. (20 Marks)

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10EC752

Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
Micro & Smart Systems Technology

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Explain the components of a smart system with the help of a block diagram. List the general requirements of a smart system. (10 Marks)
b. Mention the applications of smart materials and micro system. (10 Marks)

2 a. Describe the working of silicon capacitive accelerometer. (07 Marks)
b. Explain the principle of operation of piezoelectric based inkjet printhead. (07 Marks)
c. Explain the operation of a magnetic microrelay (06 Marks)

3 a. With a neat diagram, describe the process of silicon wafer preparation. (08 Marks)
b. Describe surface micromachining technique with the help of a suitable example. (08 Marks)
c. Differentiate between positive photoresist and negative photoresist. (04 Marks)

4 a. Describe in detail scaling of electromagnetic forces and electrostatic forces. (10 Marks)
b. Describe the concept of coupled electromechanics in detail. (10 Marks)

PART – B

5 a. Describe in detail the weighted residual technique. (10 Marks)
b. Explain finite element method in detail. (10 Marks)

6 a. Describe the working of a MOSFET with a suitable diagram. (10 Marks)
b. Explain how to check the stability of a system using Routh Hurwitz criterion. (10 Marks)

7 a. List and explain the issues in microsystem packaging. (10 Marks)
b. Describe any four packaging technologies used in microsystem. (10 Marks)

8 a. With a neat diagram, explain the working of a piezoresistive pressure sensor and define the terms sensitivity and offset voltage. (10 Marks)
b. Describe how to perform active vibration control of a beam. (10 Marks)

* * * * *

THE OXFORD COLLEGE OF ENGINEERING

DEPARTMENT OF MECHATRONICS ENGINEERING

V- SEM RESULT ANALYSIS AFTER REVALUATION - 2019(ODD SEMESTER)

Sub Code	Subject	Faculty Name	Total No. of students	No. of students appeared	FCD	FC	SC	Pass %	Fail	Pass	Absent	WH
15MT51	DESIGN OF MACHINE ELEMENT	Mr.CHETHAN	62	62	0	6	35	66	21	41	0	0
15MT551	WIRELESS NETWORK AND COMMUNICATION	Ms. Rani Aishwarya SN	62	62	12	18	29	95	3	59	0	0
15MT52	VIRTUAL INSTRUMRNTATION	Dr.RAJESWARI	62	61	45	10	6	98	1	60	1	0
15MT562	AUTOMATION IN MANUFACTURING	Mr. THIRUMURUGAN	62	61	24	22	15	100	0	61	1	0
15MT53	HYDRAULIUCS AND PNEUMATICS	Mr. THIRUMURUGAN	62	62	18	23	20	100	0	62	0	0
15MT54	MICRO AND SMART SYSTEM TECHNOLOGY	Mr. DHANANJAYA V	62	62	22	15	13	97	1	60	0	1
15MTL57	VIRTUAL INSTRUMRNTATION LAB	Dr.RAJESWARI	62	62	58	4	0	100	0	62	0	0
15MTL58	MICRO AND SMART SYSTEM TECHNOLOGY LAB	Mr. DHANANJAYA V	62	62	62	0	0	100	0	62	0	0

Prof. & HOD
Department of Mechatronics
The Oxford College of Engineering
Bommanahalli, Bangalore - 560 068.

Dr. R.V. PRAVEENA GOWDA
PRINCIPAL
The Oxford College of Engineering
Bommanahalli, Hosur Road
Bengaluru-560 068.

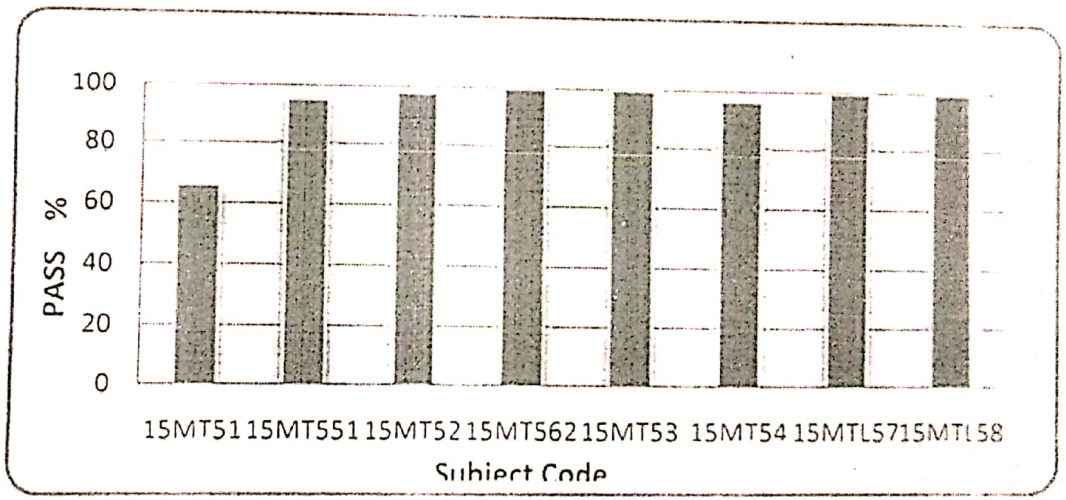
Subject Wise Topper Details

Subject Code	Name of the Student	Marks
15MT51	SANDEEP S	69
15MT551	HANUSHITHA K	85
15MT52	HANUSHITHA K	96
15MT562	AMOOLYA G	86
15MT53	PREETHAM KUMAR B	86
15MT54	AFNAN PASHA	85
15MTL57	AFNAN PASHA	98
15MTL58	KANNIKA V PAI	98

Overall Performance		65.00%
No. of students Results declared :		62
Results Withheld :		0
PASS	40	65%
FCD	21	34%
FC	18	29%
SC	1	2%
FAIL	22	35%

TOPPERS	NAMES	Marks (%)
I	HANUSHITHA K	84
II	AMOOLYA G	82
III	AFNAN PASHA	82
IV	MEGHANA V	79
V	PREETHAM KUMAR B	79

No of Subj.Failed	No of Subjects
1 subject	19
2 subjects	1
3 Subjects	0
More than 3 subjects	4



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THE OXFORD COLLEGE OF ENGINEERING
HOSUR ROAD, BOMMANAHALLI, BANGALORE - 68
Department of MechatronicsEngineering

SUBJECT CODE / SUBJECT NAME: 15MT54 MICRO AND SMART SYSTEM TECHNOLOGY

NOTE: COURSE OUTCOME CODE NEEDS TO BE IN THIS FORMAT – C232.1
(ie first digit is year , second digit is semester, third digit is subject code after dot it is first outcome means it should be written 1 second means 2 third means 3 etc – For eg if it is network analysis it should be C232.1)
Please all of you select 6 outcomes for your subject
Kindly see to that CO should relate to your subject
First and second CO should be dependent on the modules which will be kept for Internal 1
Third and fourth CO should be dependent on the modules which will be kept for Internal 2
Fifth and sixth CO should be dependent on the modules which will be kept for Internal 3

COURSE OUTCOME CODE	DESCRIPTION
C354.1	Know the basic concept of micro and smart system technology.
C354.2	Understand the need of micro size machines and devices.
C354.3	Know how this micro system technology is evolved in all fields of science amd technology
C354.4	Know the smart materials and their characteristics for the smart system applications.
C354.5	Understand the working of different sensors for smart system applications.
C354.6	Know how the different components of smart systems ate integrated with each other.

MARK – 3 , 2 AND 1 (depending on which CO is matching with which attribute and how it is mapped)
(Pl... give the explanation for the mapping at the back side of the paper)

Graduate Attributes of NBA	CO – 1	CO – 2	CO – 3	CO – 4	CO – 5	CO – 6
PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	1	1	1		
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	2	2	2	3	1
PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	2	2	2	2	2
PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions		3	3	2	2	
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations	2					
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	1	3	2	2	
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.						
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.						
PO8: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.						
PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	1	2	2	1	
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	2	1	3	3	1	
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	2	2	2	2	2

Ashoka S K
FACULTY NAME

H. Ray
PRINCIPAL

HOD / MT

Co-pso justification:

C476.1 po1. Apply the knowledge of mathematic Science, Engineering fundamentals and an engineering Specialization to the solution of Complex engineering problems.

C476.1. po2: use research based knowledge an research method & including design of experiments.

352.3 po1 :- Apply the knowledge in two dimensional Transformation & homoge -neous co-ordinations.

302. 1. po1, the Basic knowledge of line drawing and wipping representation could to apply in engineering computer graphics problems.

352. 2 po3. using two dimensional trans -formation. find the enginoingpbm solution.

52. 3 po1 - Apply using two dimensional transformation find the engineering Pbm Soln.

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Children's Education Society ®

THE OXFORD COLLEGE OF ENGINEERING

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Website: www.theoxford.edu Email : engprincipal@theoxford.edu
(Approved by AICTE, New Delhi, Accredited by NBA, New Delhi & Affiliated to VTU, Belgaum)

STUDENT MENTOR REGISTER

Name of the Student	:	B R M Thrigunyeshwari
USN	:	10X18EE009
Batch	:	2018-19
Branch	:	EEE

PRINCIPAL
The Oxford College of Engineering
Bommanahalli, Hosur Road

Vision

To be a respected and most sought after Engineering Educational Institution engaged in equipping individuals capable of building learning Organizations in the new Millennium

Mission

To Develop Competent students with good value systems and face challenges of the continuously changing world.

Children's Education Society ®

THE OXFORD COLLEGE OF ENGINEERING

Hosur Road, Bommanahalli, Bengaluru 560 068

080-30219601/02, Fax : 080-25730551,30219629

Website:www.theoxford.edu Email : engprincipal@theoxford.edu

(Approved by AICTE, New Delhi, Accredited by NBA, New Delhi & Affiliated to VTU, Belagavi)

STUDENT MENTOR REGISTER

Name of the Student	:	B·R·M·THRIGUNYESHWARI
USN	:	1DX18EE009
Batch	:	2018 - 22
Branch	:	ELECTRICAL & ELECTRONIC ENGINEERING

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Sl.No.	Name of the Mentor	Designation	Mentor Period		Signature of the Mentor
			From	To	
1.	Sumitha T.L	Asst. Prof	27/8/18	Dec 2018	
2.	Sumitha T.L	AP	Jan-19	June-19	
3.	Sumitha T.L	Asst-Prof	July 2019	Dec 2019	
4.	Sumitha T.L	Asst-Prof	Jan 2020	July 2020	
5.	Sumitha T.L	Asst. Prof	Aug 2020	Jan 2021	
6.	Sumitha T.L	Asst. Prof.	Feb 2021	July 2021	
7.					
8.					

TO BE FILLED WITH BLOCK LETTERS ONLY

Name of the Student : B.R.M.THRIGUNYESHWARI

University Seat Number : 10X18EE009

Degree/Branch : ELECTRICAL AND ELECTRONIC ENGINEERING

Date of Birth (DD/MM/YYYY) : 05/05/1999

Religion/ Community/Caste : HINDU LINGAYATS JANMARA

Year of Admission : 2018 Nature of Admission: CET/~~MGMT~~. CETNo. AZ261 CET Rank 111654

Hosteller /Day Scholar : ~~DAY~~ SCHOLAR.

Languages Known : ENGLISH, KANNADA, HINDHI

Blood Group : A+ Height & Weight : 5.0 1 70

Mobile No./E-Mail. Id : 9148224666 / BRM.THRIGUNYESHWARI@YAHOO.COM

Name	Qualification /Occupation Designation	Office Address With Phone No.	Mobile No./Email Id.
Name of Father B.R.M. HEMA MAHESHWAR.	B.E. (CS) SOFTWARE ENGINEER.	KALYANI PLATINA, EPIP ZONE, -2, WHITEFIELD, BANGALORE, KARNATAKA - 560066	9945500094 HEMA_MAHESHWAR@YAHOO.CO.IN
Name of Mother M.G. SHOBHA MANGALA	B.COM HOUSE WIFE	9148223666	9148223666
Name of Guardian			

Address of Communication:

a) Permanent Address

H/No 555, 3rd Cross, RBI Layout,
Near Brigade Millenium, Bangalore,
Karnataka

Pin:

Phone No: 9945500094

b)Communication Address

H/No 555, 3rd Cross, RBI Layout,
Near Brigade MILLENIUM, Bangalore,
Karnataka

.Pin:

Phone No: 9945500094

Method of Examination Preparation : Daily studying

Fluency in English? Yes/No : Yes

How do you prepare to improve yourself in spoken english : Reading books,

Signature of the Student

Signature of the Mentor

Signature of the HOD

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Parents - Teacher Meeting

Sl.No.	Date of Visit	Reason for Visit	Remarks from Class Teacher/ HOD	Signature of Mentor	Signature of Parent
1	4/12/18	To know the academic status	Attendence to be improved.		
2					
3	21/5/19	To inform the attendence status	Poor attendance	21/5/19	
4	30/11/19	To collect hall ticket	Condonation list	30/11/19	
5					
6					
7					
8					

Signature of the Mentor

Signature of the HOD

SCHOLARSHIP DETAILS

Sl.No.	Academic Year	Class obtained with %	Amount

SPONSORSHIP

Sl.No	Date of Conference	Conference/ Project Details	Amount

INTERNSHIP TRAINING

Sl. No.	**Period**	**Name of the Organization**

I SEMESTER

Attendance & Performance in Internal Assessment Test **Max Marks:** 40

Sl. No	Sub Code	Subject Name	IA Test-I				IA Test-II				IA Test-III				Final Marks
			Attendance			Marks	Attendance			Marks	Attendance			Marks	
			CT	CA	%	30	CT	CA	%	30	CT	CA	%	30	40
1	18MAT11	Calculus & Linear Algebra	21	10	48	17	37	22	59	11	65	43	66	15	24
2	18CHE12	Engg. chemistry	22	11	50	19	44	25	57	29	67	44	66	29	33
3	18CPS13	C programming	18	17	94	20	30	21	70	18	55	42	76	23	30
4	18ELN14	Basic Electronics	20	12	60	12	31	18	58	11	58	46	79	23	25
5	18ME15	Elements of Mechanical Engg.	20	16	80	14	30	23	77	19	51	39	76	23	26
6	18EGH18	Technical English-I	10	4	40	13	14	8	57	11	24	18	75	21	23
7	18CHEL16	Engg. chemistry Lab	4	3	75	–	8	6	75	–	14	14	100	–	30
8	18CPL17	C prog. Lab	6	6	100	–	9	9	100	–	11	11	100	–	37

CT=No. of Classes Taken CA=No. of Classes Attended

Overall % of attendance in I semester: 79.8 %

Signature of the Student

Signature of the Mentor

Signature of the HOD

Counselling	Date/Time	Identified Shortfalls in the Academic Performance	Student Remarks	Signature	
				Student	Mentor
Counselling After 1st IA Test	29/10/18	Poor attendance, Average performance, Needs improvement	will study well.	Hrigu	
Counselling After 2nd IA Test	01/12/18	Irregular to classes, No improvement seen in studies & attendence	will attend the classes regularly.	Hrigu	
Counselling After 3rd IA Test	12/01/19	Average marks, Very irregular to classes	will improve my marks and attendence	Hrigu.	

Hrigu.
Signature of the Student

Signature of the Mentor

Signature of the HOD

I SEMESTER UNIVERSITY RESULTS

Arrears (if any) : NIL **SGPA/%:** 6.5 / 58.38 % **CLASS OBTAINED :** SC

Sub Code	18MAT11			18CHE12			18CPS13			18ELE14/15			18ME15/16			18CHEL17			18CPSL17			18ECH18		
SubName	Calculus & linear Algebra			Engg. chemistry			C prog.			Basic Electronics			Mechanical Engg.			Chemistry Lab			C prog. Lab			Technical English.		
Month& Year	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T
Jan 2019	24	31	55	33	30	63	30	32	62	25	21	46	26	21	47	30	42	72	37	31	68	23	31	54

IA=Final IA Marks Ext.= External Exam Marks T=Total(IA+Ext.)

467 / 800

Counselling after University Results

Date of Counselling	Time	Mentor Notes	Student Remarks
20/3/19	2.30 to 2.45 pm	Have to improve the marks and get first class	Sorry, will improve marks for first class in next sem.

Signature of the Student Signature of the Mentor Signature of the HOD

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UNDERTAKING BY STUDENT

I, B.R.M. Thriguneshwari, USN 1OX18EE009, studying B.E in 1st semester, am aware that I have attendance shortage as on today and the statutory requirement for appearing VTU exam is 85%.

I assure that I shall be regular to the classes from now onwards. In case, I am detained due to shortage of attendance, I am solely and wholly responsible for detention.

Date: 11/9/19.

Signature of the Student

UNDERTAKING BY PARENT

I am aware that my ward _____, USN studying B.E in _____ semester is having attendance shortage as of today (Date:) and the statutory requirement for appearing VTU exam is 85%.

I assure that my ward will be regular to the classes from now onwards. In case, He/She is detained due to shortage of attendance, my ward will solely and wholly responsible for detention.

Date:

Name of the Parent:

Relationship:

Mobile No:

Signature of the Parent/Guardian

II SEMESTER

Attendance & Performance in Internal Assessment Test **Max Marks:** 40

Sl. No	Sub Code	Subject Name	IA Test-I				IA Test-II				IA Test-III				Final Marks
			Attendance			Marks	Attendance			Marks	Attendance			Marks	
			CT	CA	%	30	CT	CA	%	30	CT	CA	%	30	40
1	18MAT21	Advanced Calculus	20	11	55	26	42	32	76	23	48	37	77	20	29
2	18PHY22	Engg. Physics	22	13	59	26	48	30	63	27	61	47	77	25	36
3	18ELE23	Basic Electrical Engg.	17	11	65	11	35	21	60	19	48	36	75	17	25
4	18CIV24	Elements of Civil Engg.	20	10	50	0	48	45	94	21	52	51	98	17	23
5	18EGDL25	Engg. Graphics	14	10	71	-	35	20	57	-	46	30	65	-	34
6	18PHYL26	Physics Lab	5	4	80	-	11	10	91	-	13	11	85	-	38
7	18ELEL27	Electrical Lab	5	5	100	-	11	10	91	26	13	11	85	-	30
8	18EGH28	Technical Eng-II	8	5	63	15	17	11	65	17	24	18	75	17	23

CT=No. of Classes Taken CA=No. of Classes Attended

Overall % of attendance in II semester: 79.63 %

Signature of the Student

Signature of the Mentor

Signature of the HOD

Counselling	Date/Time	Identified Shortfalls in the Academic Performance	Student Remarks	Signature	
				Student	Mentor
Counselling After 1st IA Test	27/4/19	Not attended civil classes.	Will attend regularly.	Abhijit	
Counselling After 2nd IA Test	24/5/19	Attendance less; Less score in Basic electrical.	will score more marks.	Abhijit	
Counselling After 3rd IA Test	15/6/19	Less marks in Civil Engg & Electrical Engg.	will work hard.	Abhijit	

Signature of the Student **Signature of the Mentor** **Signature of the HOD**

II SEMESTER UNIVERSITY RESULTS

Arrears (if any) : NIL **SGPA/%:** 63.63 % **CLASS OBTAINED :** FC

Sub Code	18MAT21			18PHY22			18ELE23			18CIV24			18EGDL25			18PHYL26			18ELEL27			18ECH28		
SubName	Advanced Calculus			Engg. Physics			Basic Electrical Engg.			Engg. Civil			Engg. Graphics			Physics Lab			Electrical Lab			Technical English		
Month& Year	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T
July 2019	29	33	62	36	21	57	25	23	48	23	23	46	34	42	76	38	54	92	30	37	67	23	38	61

IA=Final IA Marks Ext.= External Exam Marks T=Total(IA+Ext.)

509/800

Counselling after University Results

Date of Counselling	Time	Mentor Notes	Student Remarks
20/8/19	1:45 to 1:55 pm	Can improve in Basic Electrical, Graphics	Noted. Will improve the marks.

Signature of the Student

Signature of the Mentor 20/8/19

Signature of the HOD

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UNDERTAKING BY STUDENT

I, B.R.M. Thriguneshwari, USN 10X18EE009, studying B.E in IInd. semester, am aware that I hav attendance shortage as on today and the statutory requirement for appearing VTU exam is 85%.

I assure that I shall be regular to the classes from now onwards. In case, I am detained due to shortage of attendance, I am solely and wholly responsible for detention.

Date: 11/04/19

Signature of the Student

UNDERTAKING BY PARENT

I am aware that my ward _____, USN studying B.E in _____ semester is having attendance shortage as of today (Date:) and the statutory requirement for appearing VTU exam is 85%.

I assure that my ward will be regular to the classes from now onwards. In case, He/She is detained due to shortage of attendance, my ward will b solely and wholly responsible for detention.
Date:

Name of the Parent:

Relationship:

Mobile No:

Signature of the Parent/Guardian

III SEMESTER

Attendance & Performance in Internal Assessment Test **Max Marks:** 40

Sl. No	Sub Code	Subject Name	IA Test-I 12/9/19 – 14/9/19				IA Test-II				IA Test-III				Final Marks
			Attendance			Marks	Attendance			Marks	Attendance			Marks	
			CT	CA	%	30	CT	CA	%	30	CT	CA	%	30	40
1	18MAT31	Maths - III	18	14	77	16	30	20	67	15	52	35	68	30	31
2	18EE32	ECA	21	15	71	21	37	28	76	24	62	47	76	24	33
3	18EE33	T & G	18	14	77	21	30	23	77	15	55	37	68	13	27
4	18EE34	AEC	20	15	75	19	30	23	77	16	50	38	76	25	30
5	18EE35	DSD	16	11	69	24	34	26	76	21	66	50	76	15	30
6	18EE36	EEM	16	11	69	19	35	32	91	23	51	37	73	20	31
7	18EEL37	Machines lab. I	7	5	71	–	9	8	89	–	12	11	92	–	37
8	18EEL38	Electronics Lab	7	5	71	–	9	7	78	–	12	10	83	–	32

CT=No. of Classes Taken CA=No. of Classes Attended

Overall % of attendance in III semester: 74 %

Signature of the Student

16/12/19
Signature of the Mentor

Signature of the HOD

Counselling	Date/Time	Identified Shortfalls in the Academic Performance	Student Remarks	Signature	
				Student	Mentor
Counselling After 1st IA Test	20/9/19	Irregular to classes, work hard to improve the score	Yes will score. Good	Shige	
Counselling After 2nd IA Test	25/10/19	Irregular; should improve in Math, T&C, AEC	Thank you, Will improve the score.	Shige	
Counselling After 3rd IA Test	29/11/19	Poor attendence; Should study T&D and DSD	Thank you, will improve the score	Shige	

Signature of the Student **Signature of the Mentor** **Signature of the HOD**

III SEMESTER UNIVERSITY RESULTS

Arrears (if any) : 1 **SGPA/%:** – **CLASS OBTAINED :** FAIL

Sub Code	18MAT31			18EE32			18EE33			18EE34			18EE35			18EE36			18EEL37			18EEL38		
SubName	Eng. Maths III			Electric Circuit Analysis			Transformer & Generators			Analog Electronic Circuits			Digital System Design			Measurements			Machines Lab			Electronics Lab		
Month& Year	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T
January 2020	35	29	64	33	14	47	27	23	50	30	23	53	32	30	62	31	28	59	37	54	91	32	53	85

IA=Final IA Marks Ext.= External Exam Marks T=Total(IA+Ext.)

511/800

Counselling after University Results

Date of Counselling	Time	Mentor Notes	Student Remarks
20/4/2020	3.15 to 3.30 pm	Hard work required for problematic subjects	will pass in all subjects.

Signature of the Student Signature of the Mentor Signature of the HOD

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UNDERTAKING BY STUDENT

I, B.R.M. Thrigunyeshwari, USN 1OX18CE009, studying B.E in III rd semester, am aware that I hav attendance shortage as on today and the statutory requirement for appearing VTU exam is 85%.

I assure that I shall be regular to the classes from now onwards. In case, I am detained due to shortage of attendance, I am solely and wholly responsible for detention.

Date: 10/4/2019

Signature of the Student

UNDERTAKING BY PARENT

I am aware that my ward _____, USN studying B.E in _____ semester is having attendance shortage as of today (Date:) and the statutory requirement for appearing VTU exam is 85%.

I assure that my ward will be regular to the classes from now onwards. In case, He/She is detained due to shortage of attendance, my ward will solely and wholly responsible for detention.
Date:

Name of the Parent:

Relationship:

Mobile No:

Signature of the Parent/Guardian

IV SEMESTER

Attendance & Performance in Internal Assessment Test

Max Marks:

Sl. No	Sub Code	Subject Name	IA Test-I				IA Test-II				IA Test-III				Final Marks
			Attendance			Marks	Attendance			Marks	Attendance			Marks	
			CT	CA	%	(30)	CT	CA	%	(30)	CT	CA	%	(30)	(40)
1	18MAT41	Probability and Statistical methods	18	14	77	28	30	25	83	30	52	47	91	30	39
2	18EE42	Power Generation & Economics	21	15	71	24	37	31	84	30	62	55	89	30	38
3	18EE43	Transmission & Distribution	18	14	77	29	30	26	87	30	55	51	93	30	40
4	18EE44	Electric motors	20	15	75	22	30	24	80	30	50	43	86	30	37
5	18EE45	Field Theory	20	15	75	36	34	28	82	39	64	57	89	32	37
6	18EE46	Opamps & Linear ICs	18	14	77	37	35	31	89	40	51	46	90	38	39
7	18EEL47	Machines Lab - 2	6	6	100	–	9	9	100	–	11	11	100	–	
8	18EEL48	Opamp & Linear ICs lab.	6	6	100	–	9	9	100	–	11	11	100	–	

CT=No. of Classes Taken CA=No. of Classes Attended

Overall % of attendance in IV semester: 92.25 %

Signature of the Student

Signature of the Mentor

Signature of the HOD

Counselling	Date/Time	Identified Shortfalls in the Academic Performance	Student Remarks	Signature	
				Student	Mentor
Counselling After 1st IA Test	20/4/20	Irregular to classes; should concentrate more.	will attend regularly.	Hrigu	
Counselling After 2nd IA Test	28/5/20	Regular for online classes	–	Hrigu	
Counselling After 3rd IA Test	20/6/20	Regular for online classes, should concentrate on problematic subjects.	Problematic subjects difficult to follow in online classes.	Hrigu	

Signature of the Student Hrigu **Signature of the Mentor** **Signature of the HOD**

IV SEMESTER UNIVERSITY RESULTS

Arrears (if any) : Nil **SGPA/%:** 77.88 % **CLASS OBTAINED :** FCD

Sub Code	18MAT41			18EE42			18EE43			18EE44			18EE45			18EE46			18EEL47			18EEL48		
SubName	Prob. & Statistical methods			Power Gen. & Economics			Transmission & Distribution			Electric motors			Field theory			Opamp & Linear ICs			Machines Lab-2			Op amp Lab.		
Month& Year	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T	IA	Ext	T
September 2020	50	28	78	50	28	78	50	28	78	49	28	77	50	28	78	50	28	78	50	28	78	50	28	78

IA=Final IA Marks Ext.= External Exam Marks T=Total(IA+Ext.)

623/800

Counselling after University Results

Date of Counselling	Time	Mentor Notes	Student Remarks
25/10/20	10:15 to 10:30 pm	Should work hard in problematic subjects	Ok.

Signature of the Student Signature of the Mentor Signature of the HOD

UNDERTAKING BY STUDENT

I, B.R.M. Shriganesharaj, USN 1BX18EC017, studying B.E in IV th semester, am aware that I ha attendance shortage as on today and the statutory requirement for appearing VTU exam is 85%.

I assure that I shall be regular to the classes from now onwards. In case, I am detained due to shortage of attendance, I am solely an wholly responsible for detention.

Date: 05/2/2020

Signature of the Student

UNDERTAKING BY PARENT

I am aware that my ward _____, USN studying B.E in _____ semester is having attendance shortage as of today (Date:) and the statutory requirement for appearing VTU exam is 85%.

I assure that my ward will be regular to the classes from now onwards. In case, He/She is detained due to shortage of attendance, my ward w solely and wholly responsible for detention.

Date:

Name of the Parent:

Relationship:

Mobile No:

Signature of the Parent/Guardian

PRINCIPAL
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Bommanahalli, Hosur Road
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